Research and Monitoring: Evolution, Methods and Case Studies

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South Florida/Caribbean Network I&M Program

Lessons learned from seventeen years of monitoring coral reefs

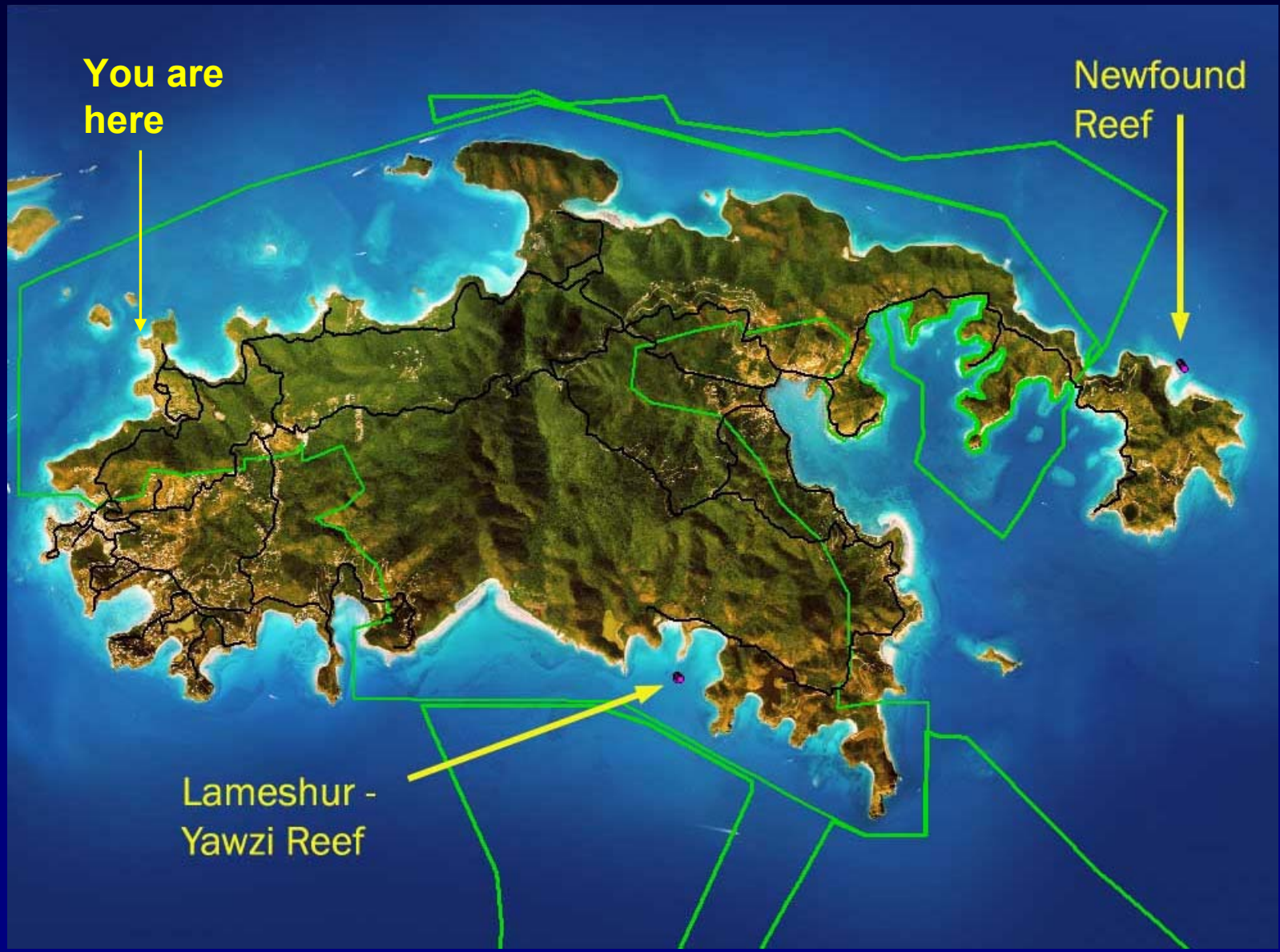
South Florida/Caribbean Network I&M Program

Lessons learned

1. Worthwhile endeavor

2. Takes time and commitment

3. Be flexible to react to change driving events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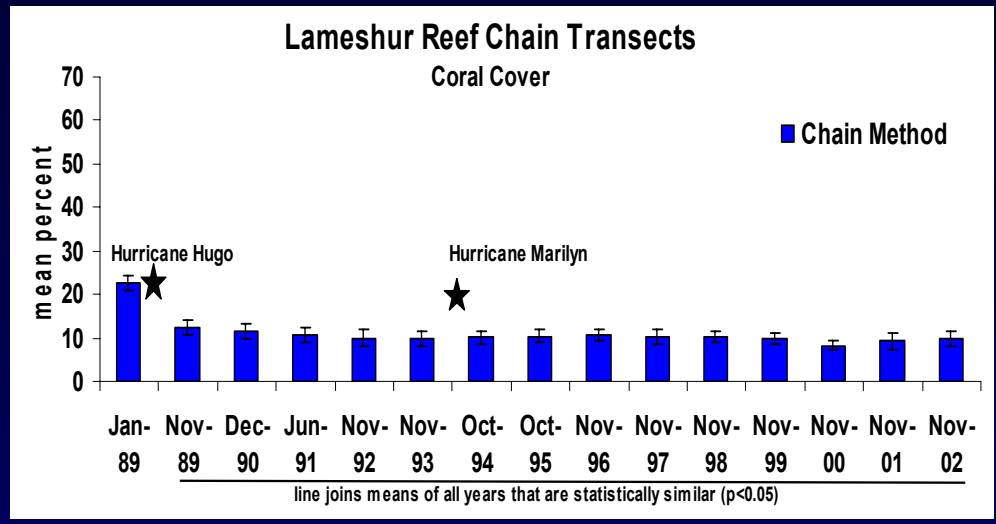
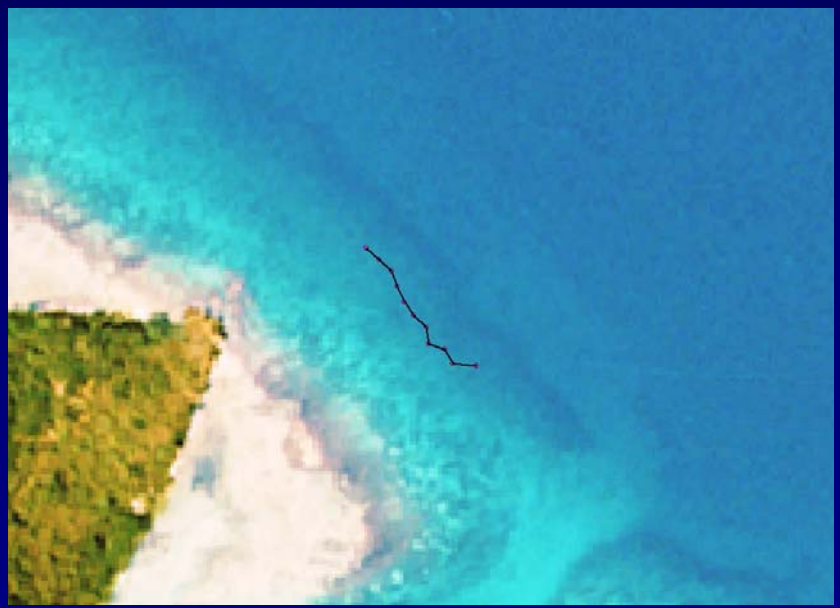
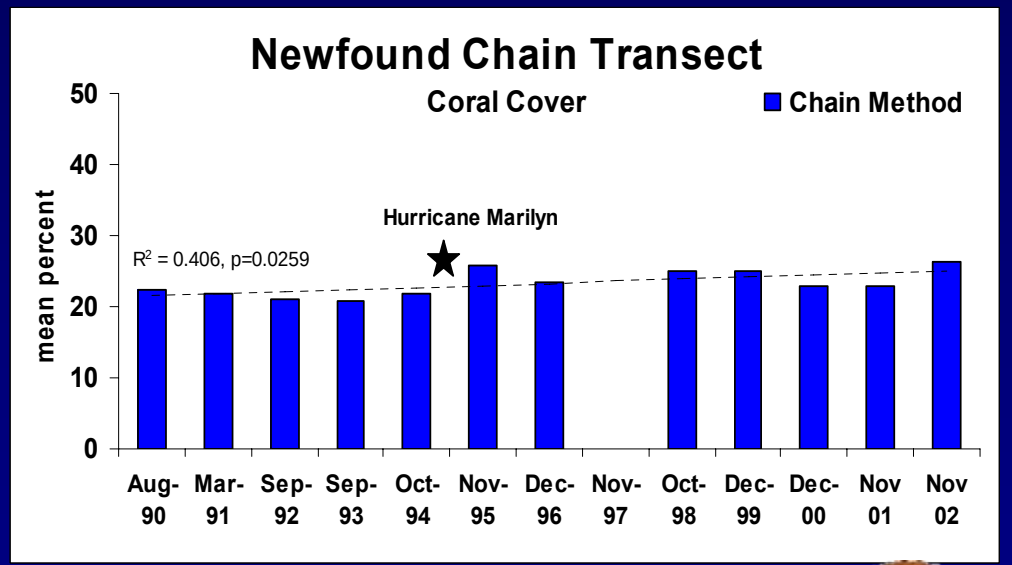
Newfound Reef
Lameshur - Yawzi Reef







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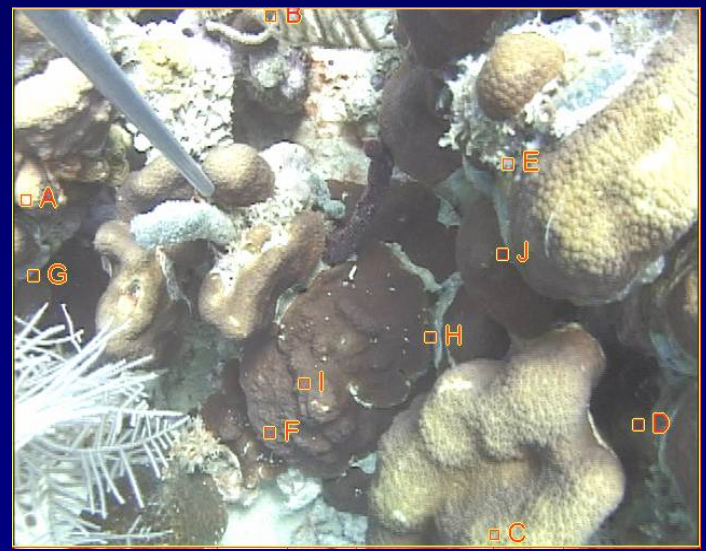
Coral Reef Monitoring Protocol



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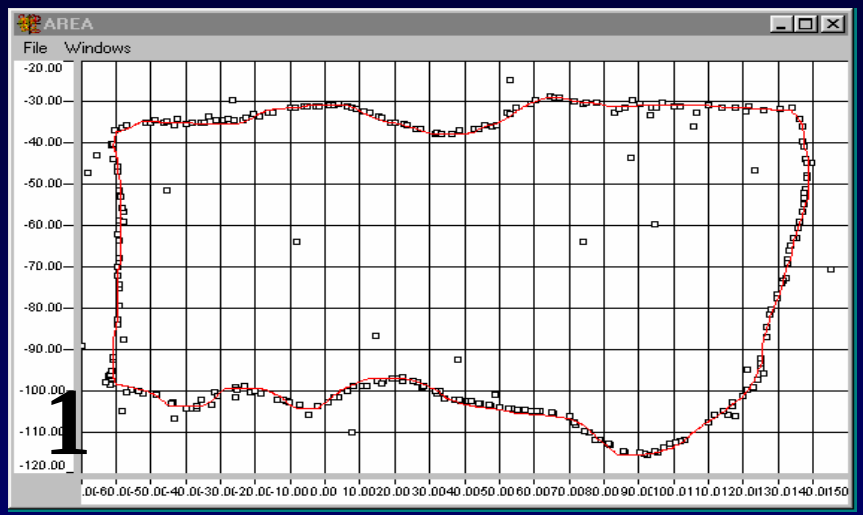
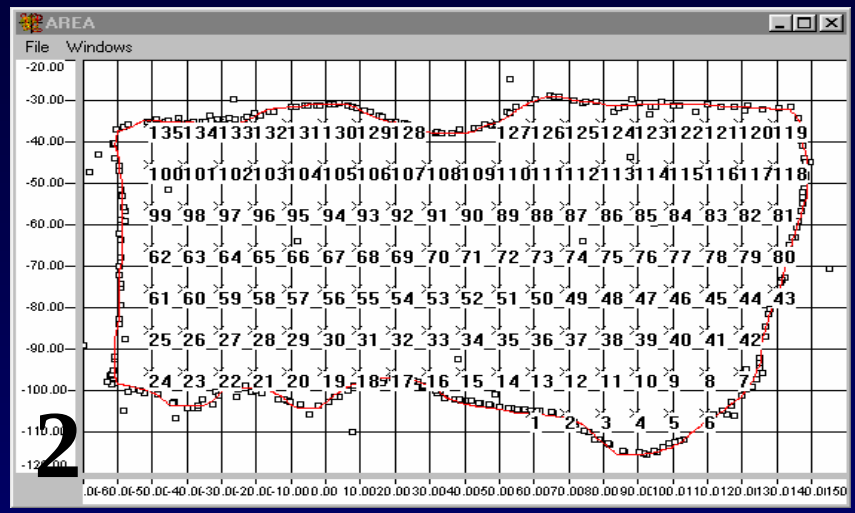
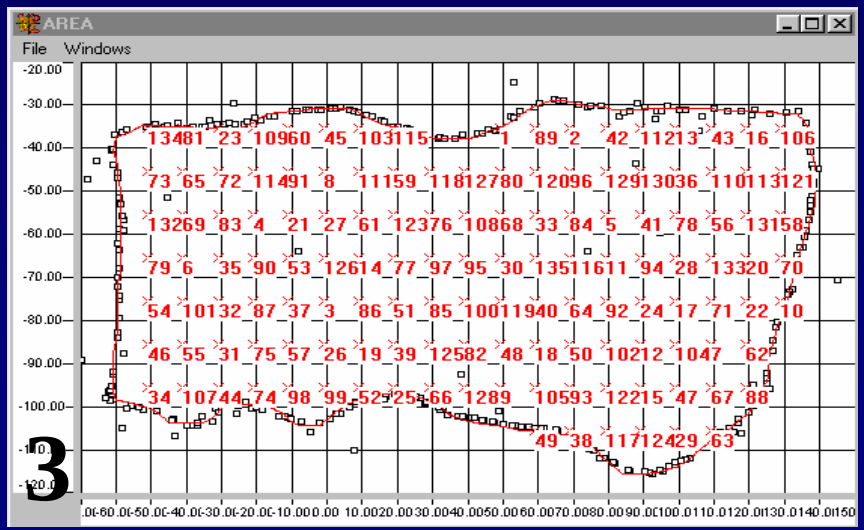
Coral Reef Monitoring Protocol

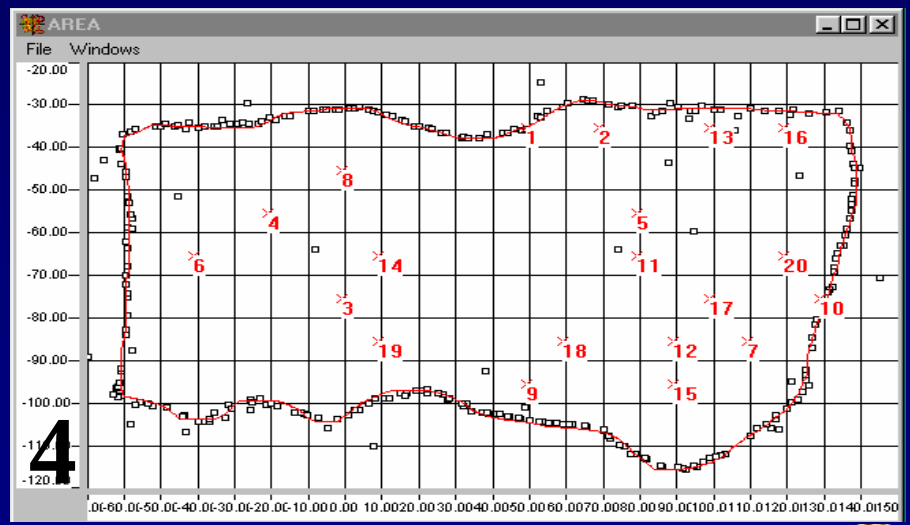
South Florida/Caribbean Network I&M Program

Coral Reef Monitoring Protocol









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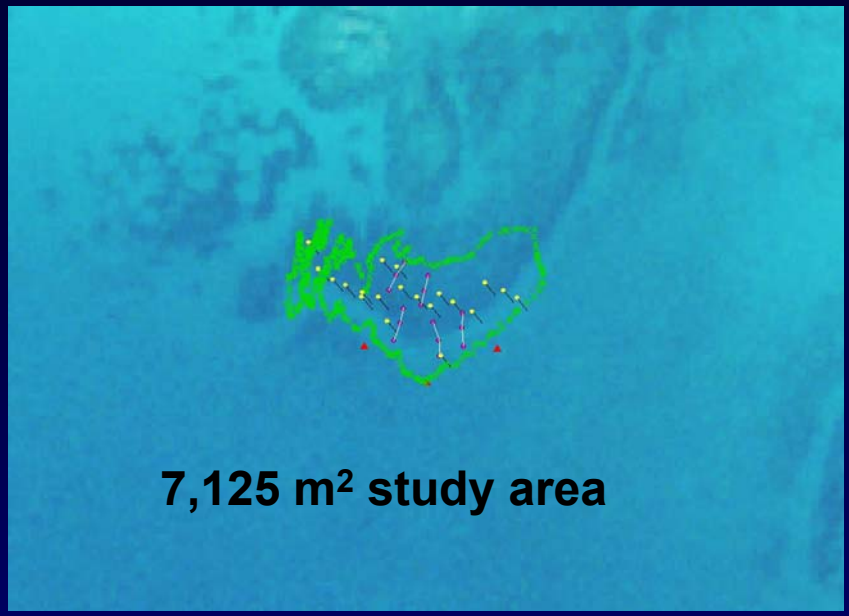

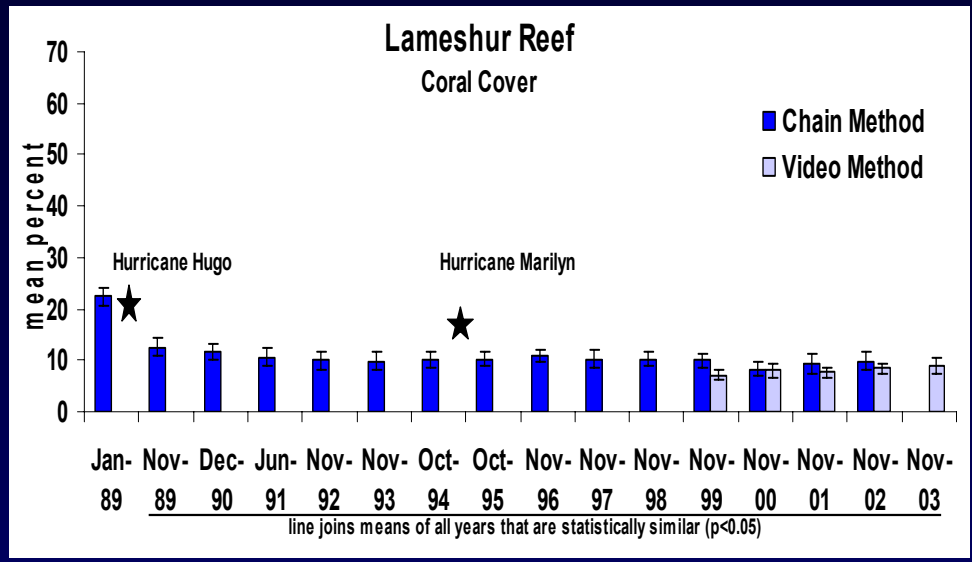

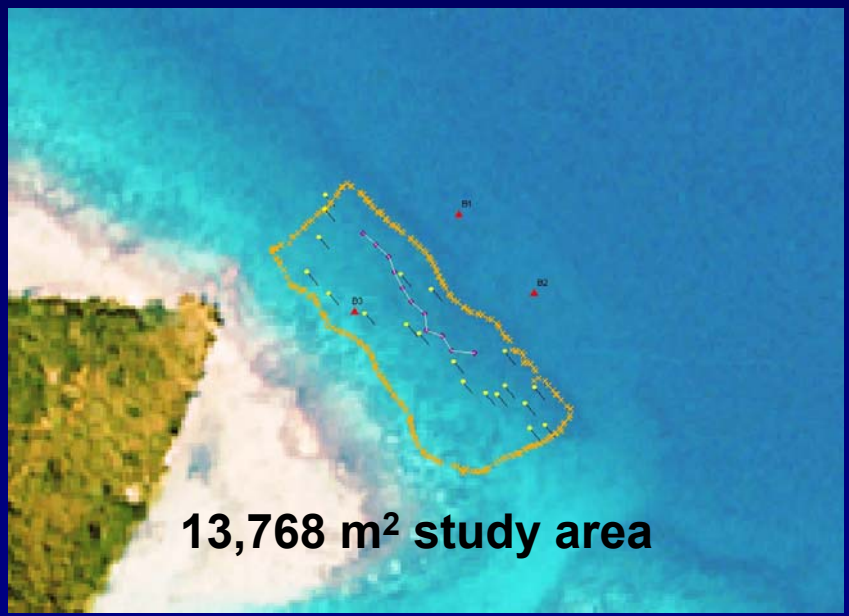

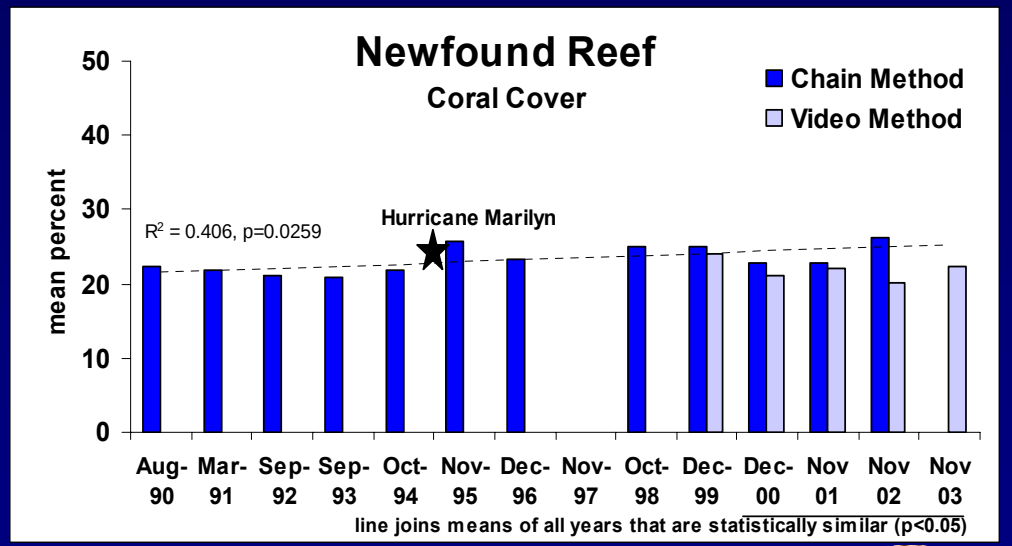

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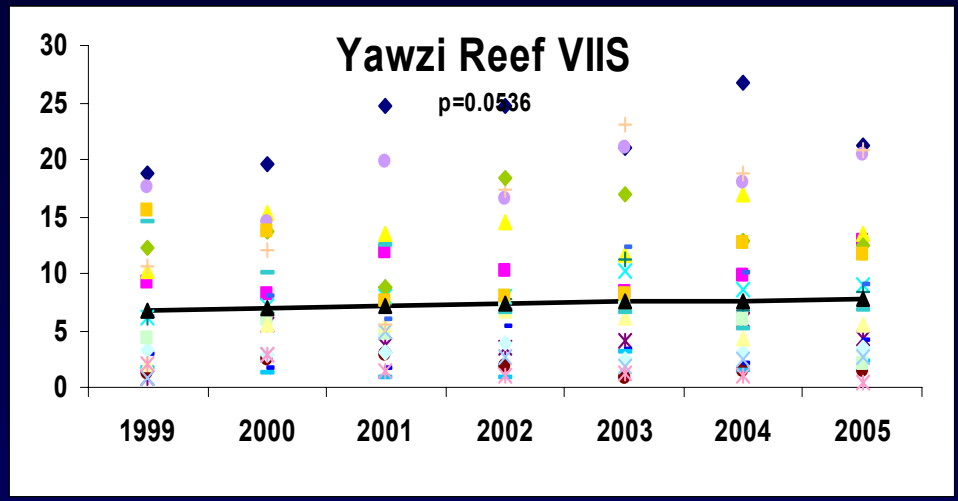

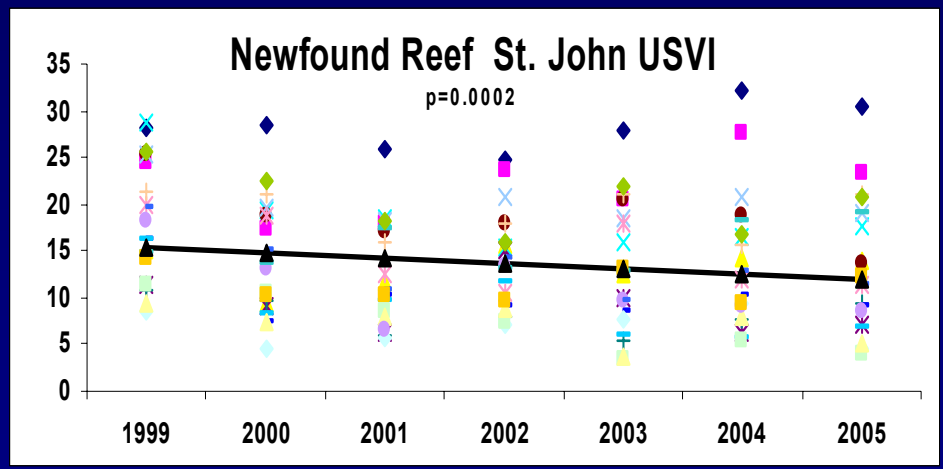

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Coral Reef Monitoring Protocol

"It requires effort to ensure that sampling is random."

Why bother ???

- Roger Green

Sampling Design and Statistical Methods for Environmental Biologists

Potential problems with haphazard sampling designs

- **Poor Inference:** Use of judgment to select sites, convenience sampling
  -> results only apply to pre-selected sites
- **Poor Stratification:** stratification is based upon strata that change through time. Includes placement of sites in temporary hot spots
  -> analysis complication, validity of trends open to question
- **Design does not match objectives:** Issues of sufficient power, appropriate scope, and appropriate link between protocol and indicator
  -> unable to answer managers' real questions in time frame needed
  -> or needless wasting of effort on detailed answers for a ill-defined question
- **Not Robust:** changes in personnel or protocol or funding affect interpreting data
  -> analysis complication, validity of trends open to question

Lessons learned

1. Worthwhile endeavor

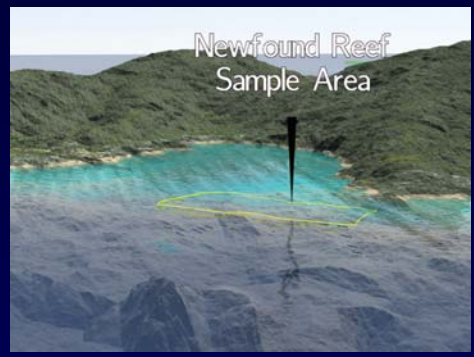
2. Takes time and commitment

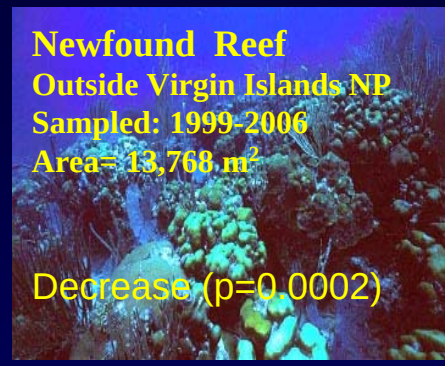
3. Be flexible to react to change driving events

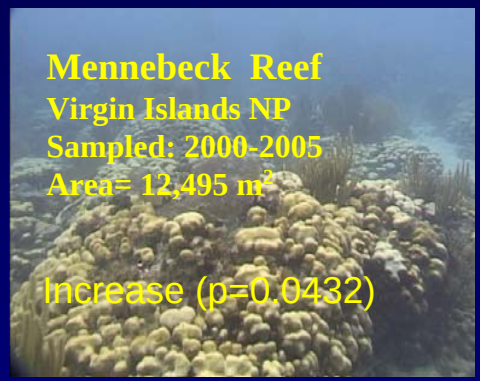
Pilot program phase (3-5 years)

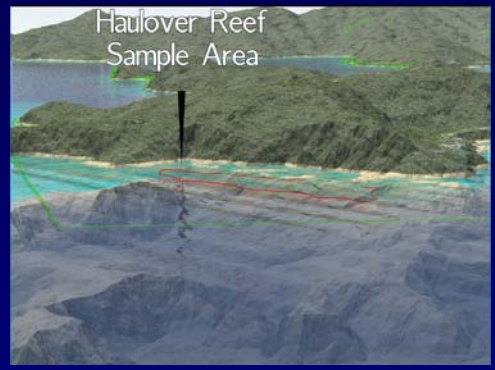
- Piloting protocols
  - Establishing variability, evaluating power & optimizing design & protocol
- Revising protocol & sampling designs
- Establishing baselines
- Long-term monitoring to evaluate change

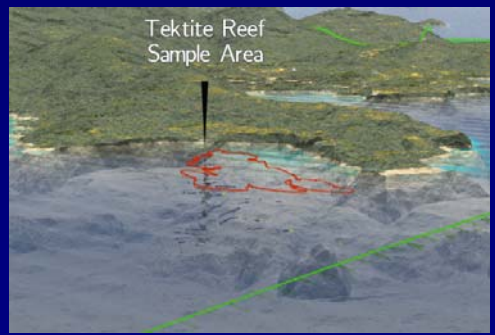
Virgin Islands National Park - STJ

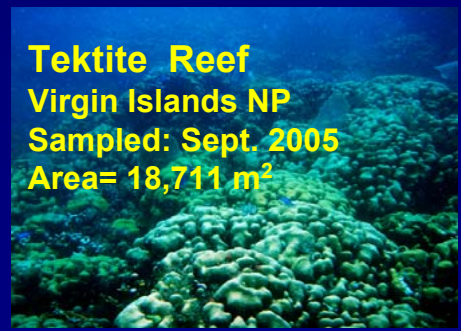












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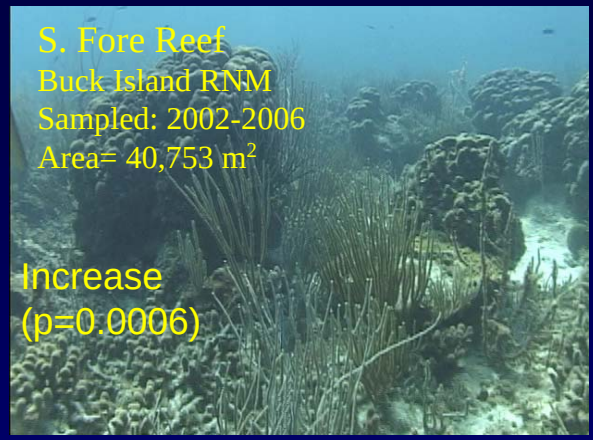
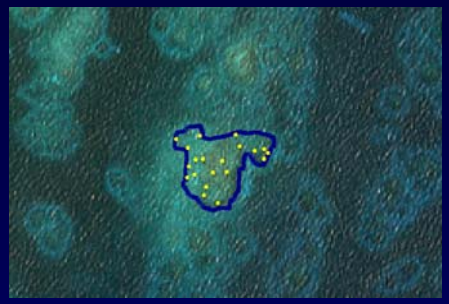
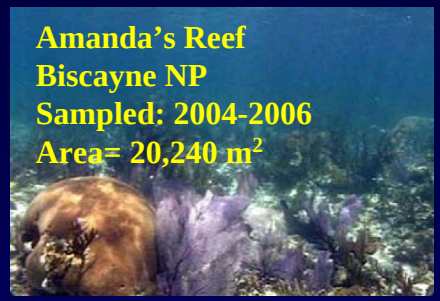
Buck Island Reef National Monument

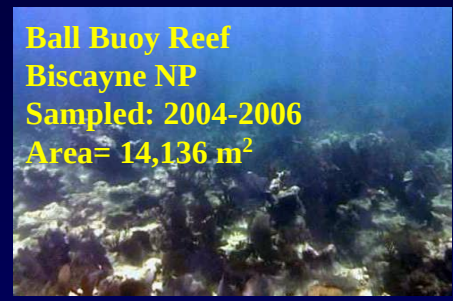


South Florida National Parks

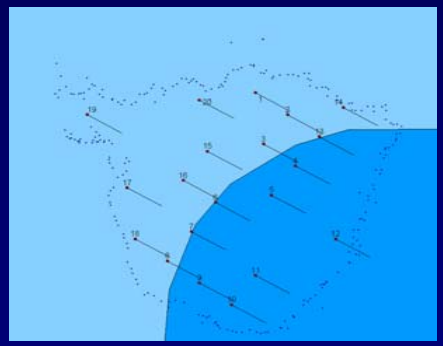
Biscayne NP

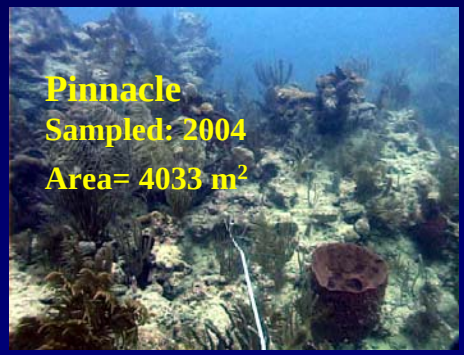


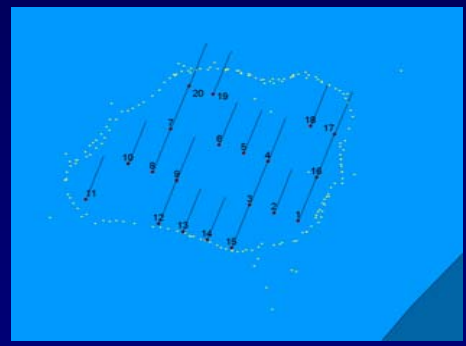




Dry Tortugas NP







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Some important questions for scientists & management…

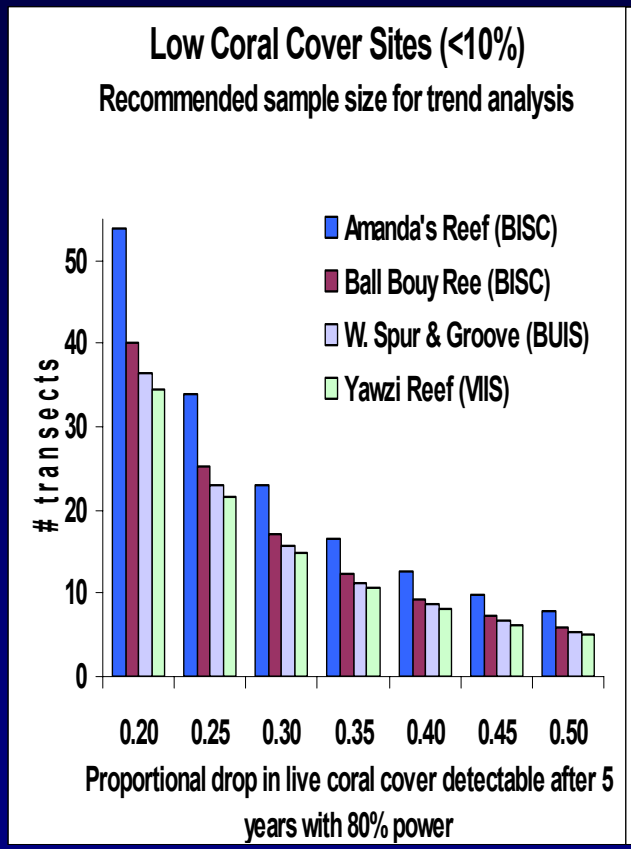
- What amount of change do you want to be able to detect?
- How confident do you need to be that you'll catch this change the first sampling event it occurs? (90%? 70%?)
- What level of "false alarms" are you willing to except? (5%? 10%?)

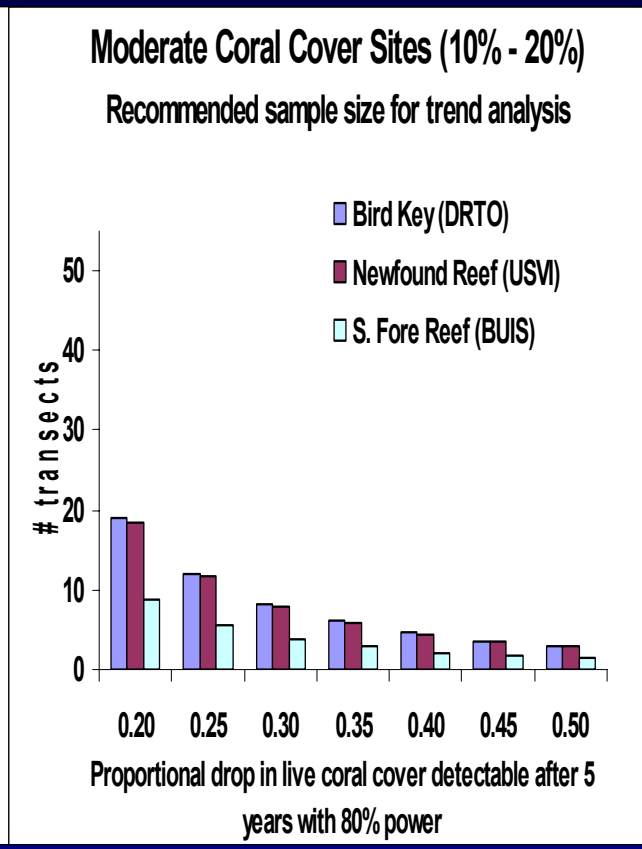
Power – detect trend 25% over 5 years

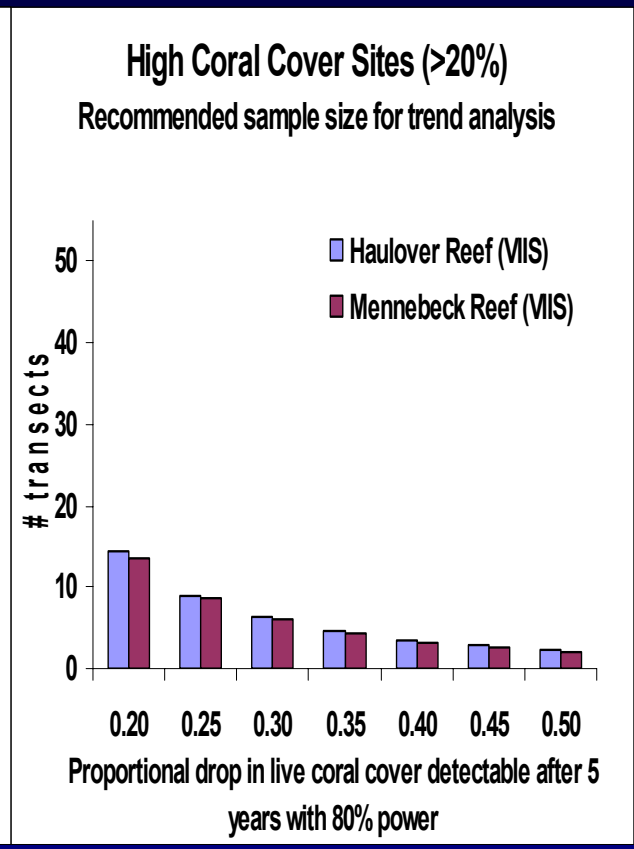
(α = 0.05, 20 permanent transects)

Site (Park/Location)	Power	Mean Coral Cover
Newfound Reef (STJ)……	92%	13.6%
Yawzi Reef (VIIS)……	74%	7.3%
Haulover Reef (VIIS)……..	96%	22.3%
Mennebeck Reef (VIIS)……..	97%	23.7%
W. Spur and Groove (BUIS) ……	76%	5.2%
S. Fore Reef (BUIS)……	99%	17.9%
Amanda's Reef (BISC)……	57%	7.0%
Ball Buoy Reef (BISC)……	70%	6.6%
Bird Key Reef (DRTO)……	91%	12.9%

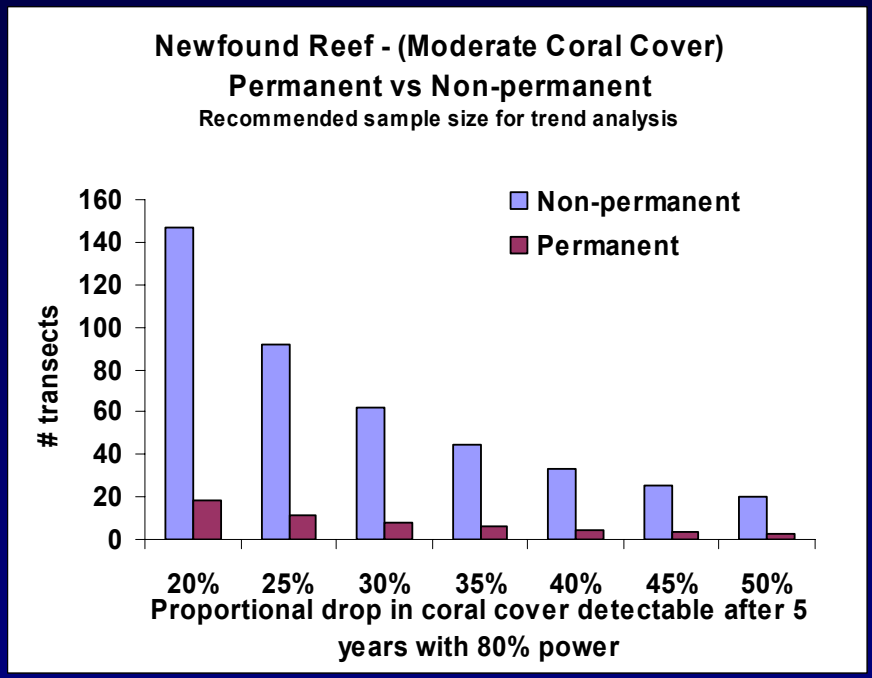
Found power and recommended sample sizes varied with average coral cover

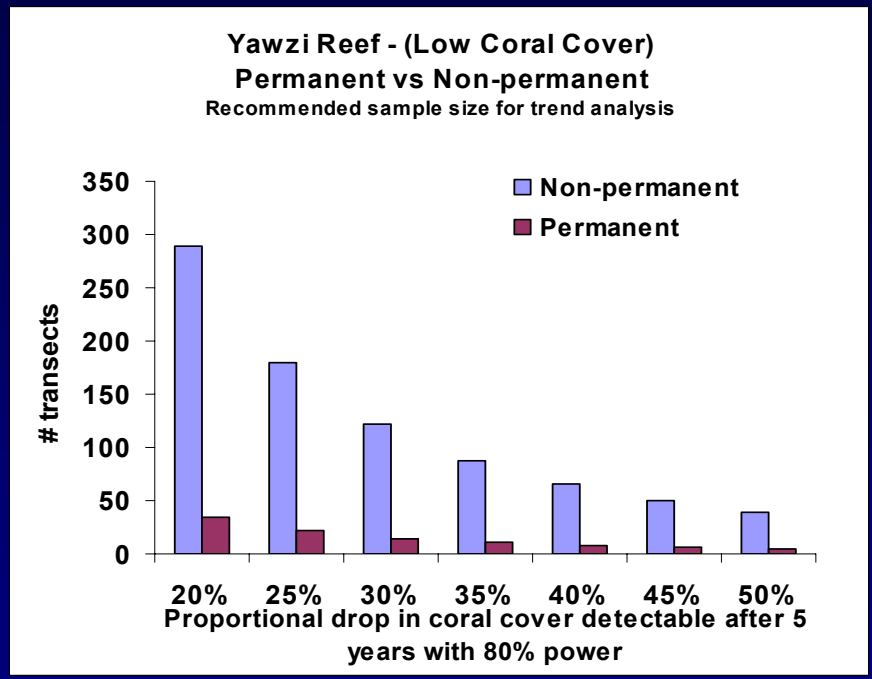






Sample Size Comparison
Permanent vs. Non-permanent Transects
($\alpha = 0.05$)





20 non-permanent transects: 21% power

92 non-permanent transects: 80% power

20 non-permanent transects: 14% power

181 non-permanent transects: 80% power

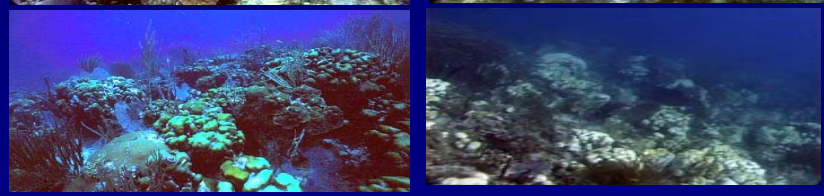
Lessons learned

1. Worthwhile endeavor

2. Takes time and commitment

3. Be flexible to react to change driving events

2005 Episodic Bleaching Event

S. Fore Reef, BUIS		95.6% coral cover bleached
Tektite, VIIS		90.2% coral cover bleached
Haulover, VIIS		96.4% coral cover bleached
Mennebeck, VIIS		93.6% coral cover bleached
Yawzi, VIIS		79.9% coral cover bleached
Newfound, STJ		91.8% coral cover bleached

90% Coral Cover Bleached

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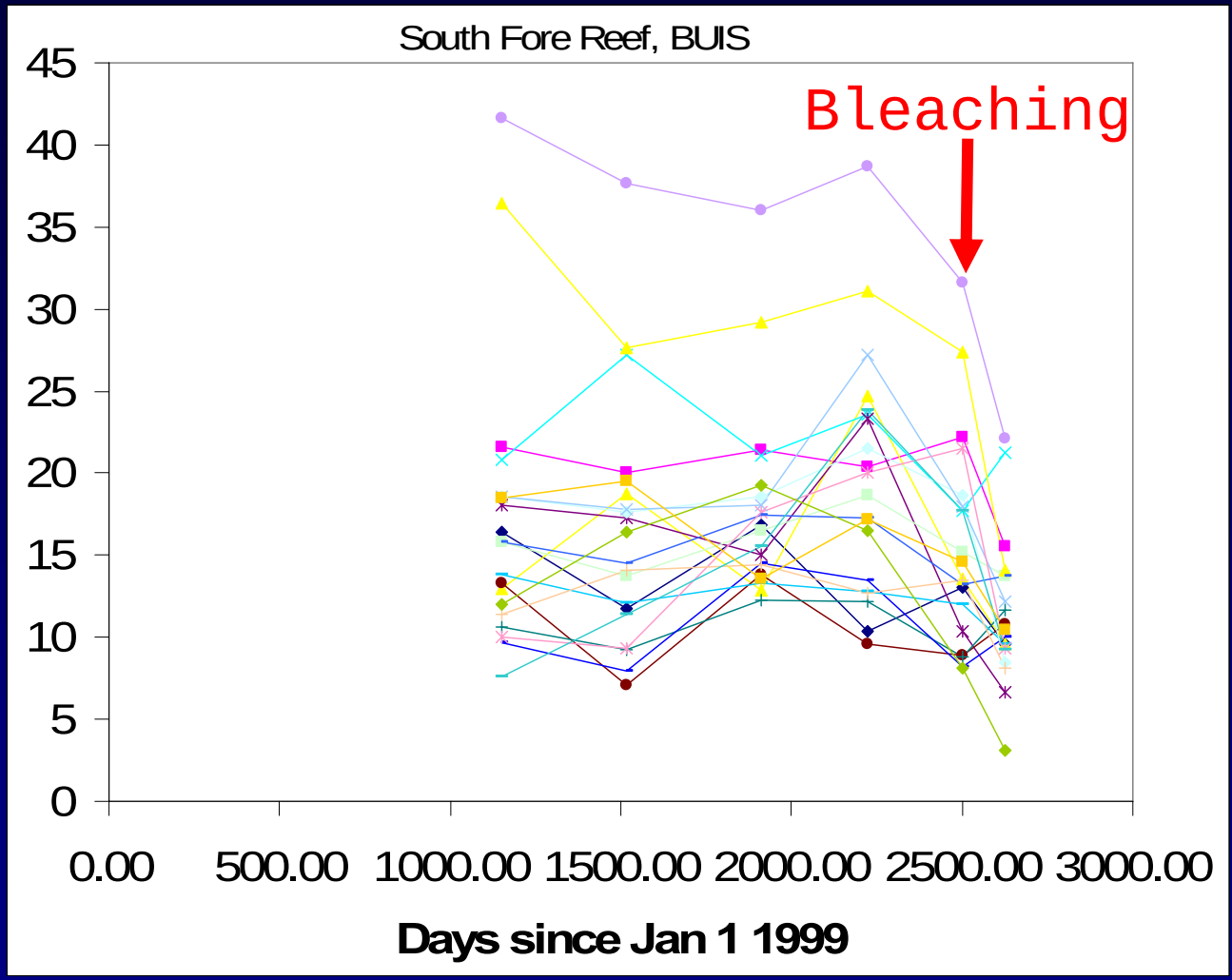
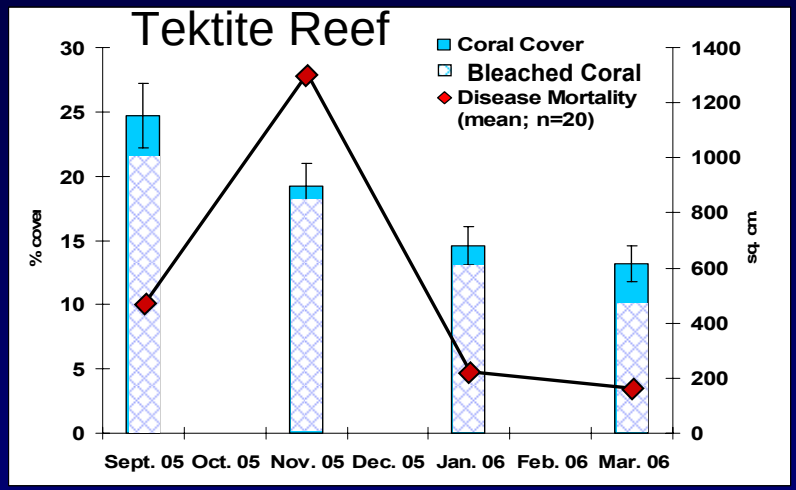
Establishing baseline allows testing for both sudden & gradual changes

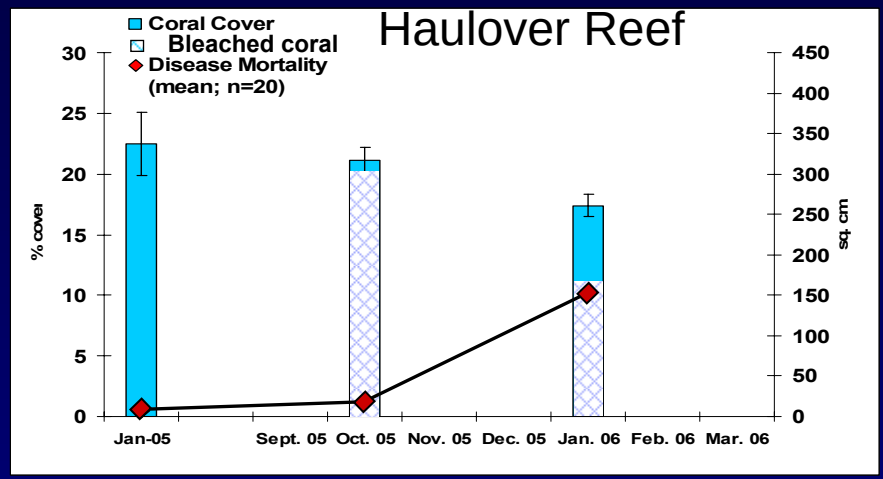


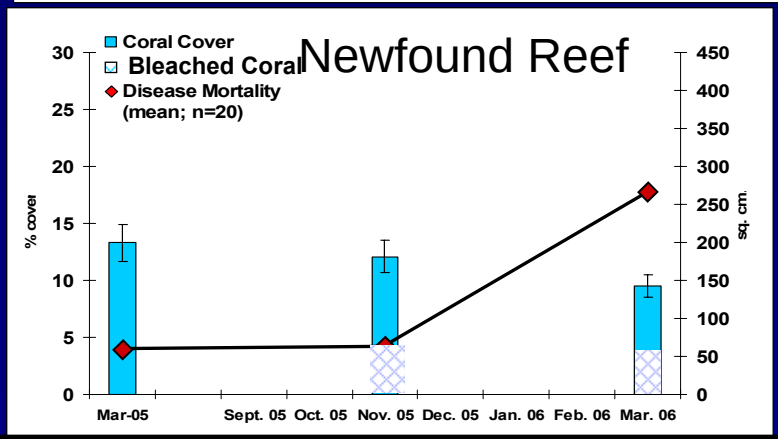
Successful and vital partnership with USGS

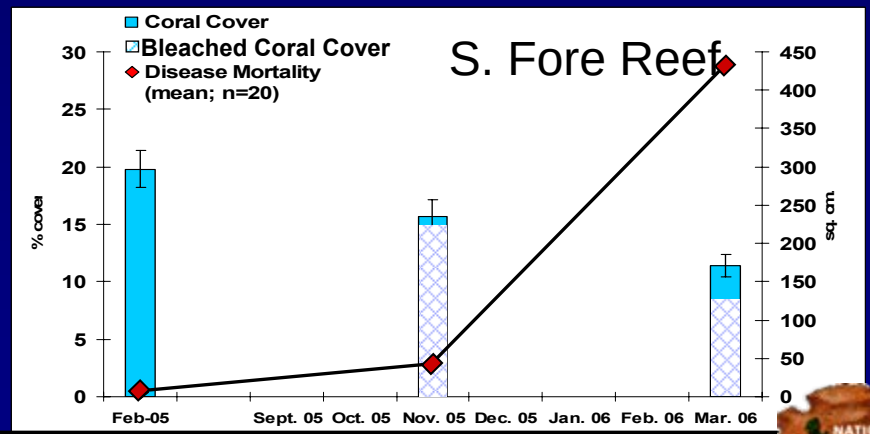
Began 2005 co-locating benthic cover with mortality from disease on permanent transects

Co-location of benthic cover and mortality from disease

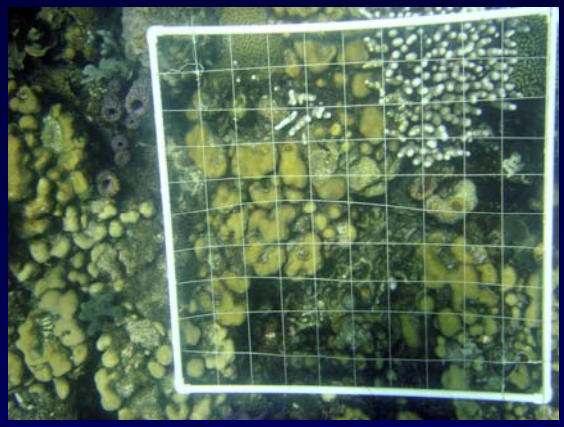




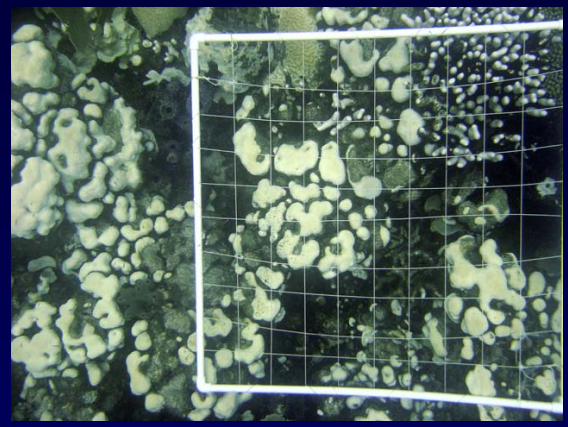




Bleaching – Disease connection



August



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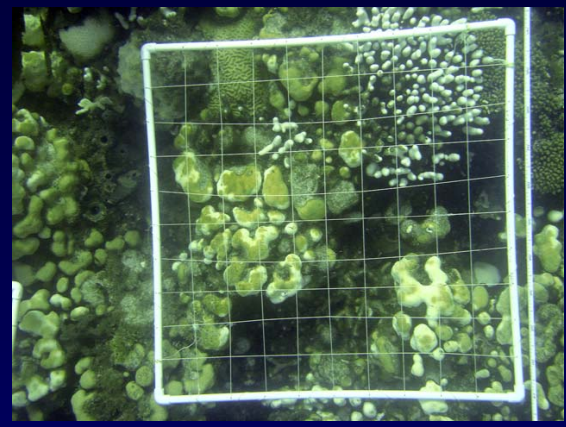
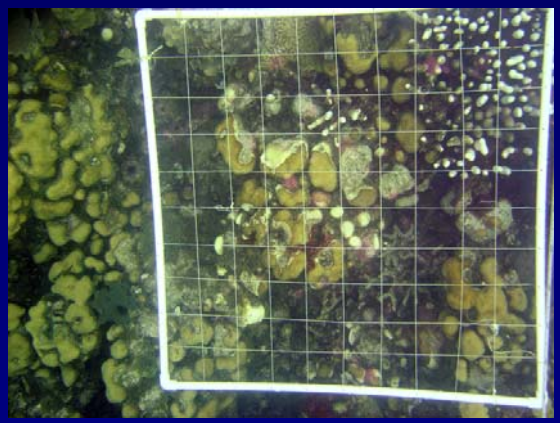
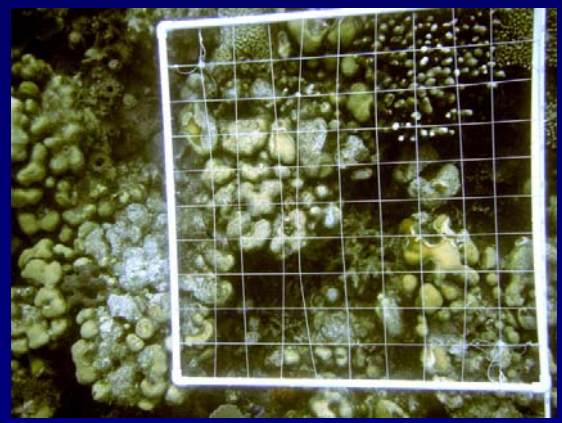


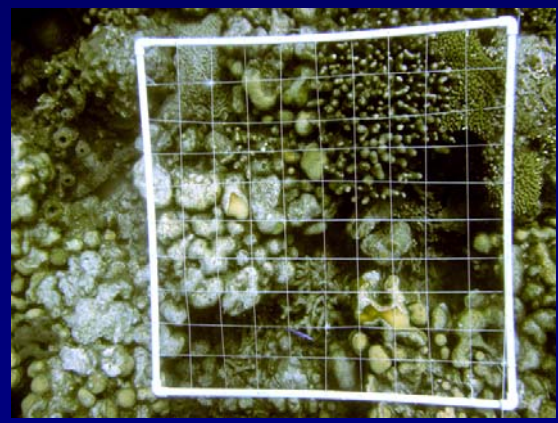
October



November



December



January

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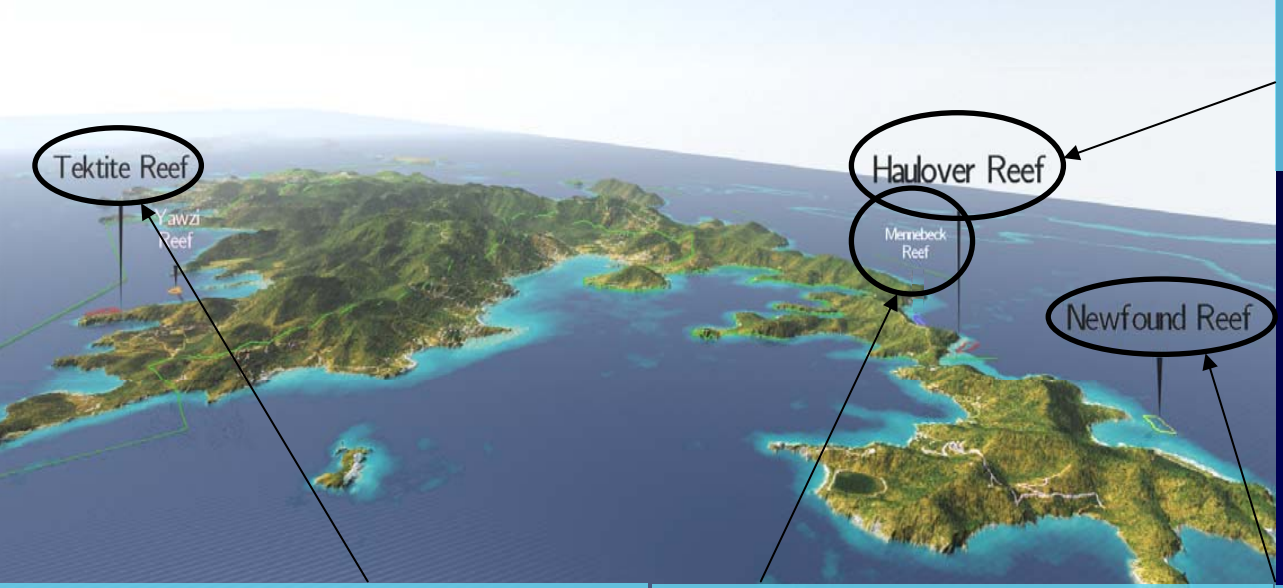

23% loss

In one Year !

48% loss

24% loss

28% loss

Tektite - in six months !!

42% loss

Stakeholder “Buy-in”

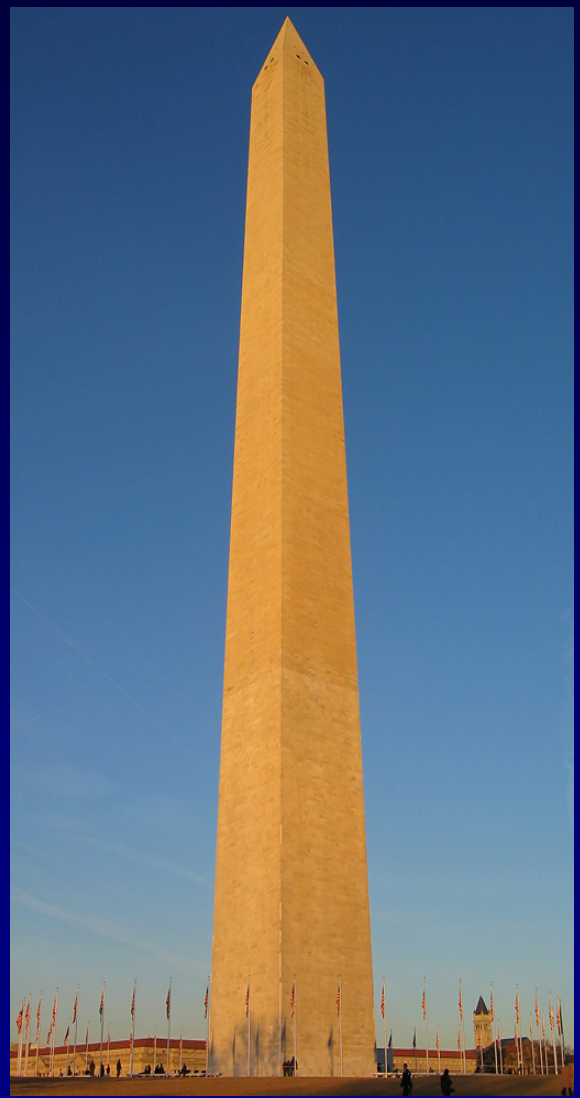

Photo by Judd Patterson

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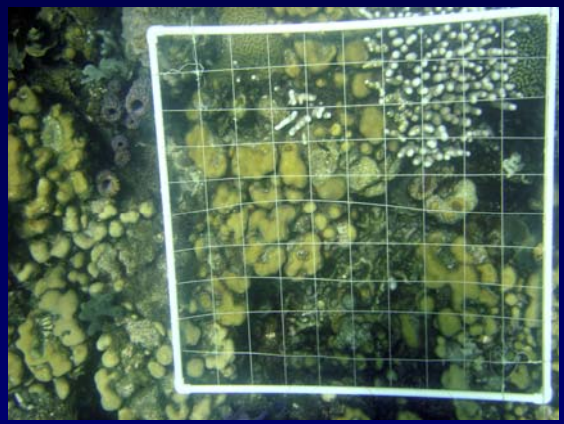
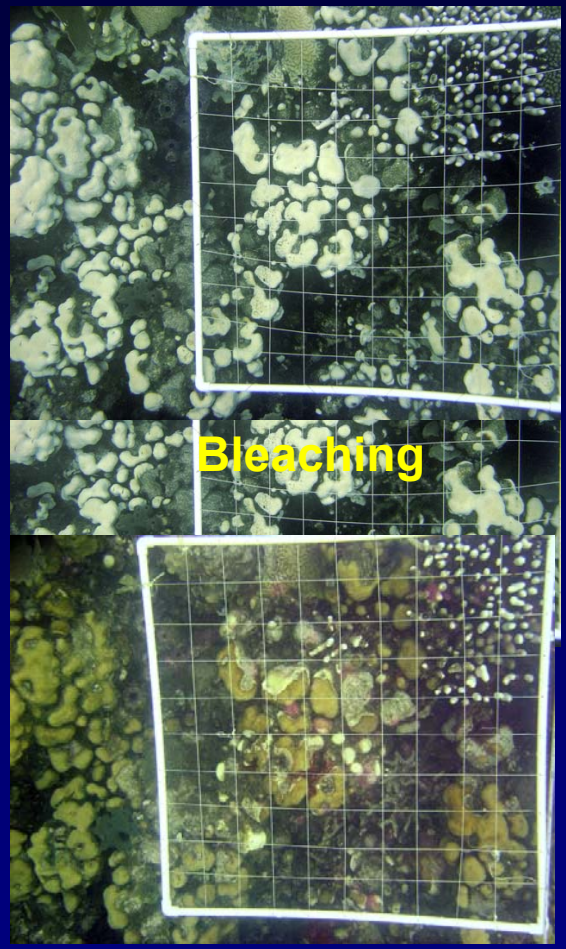
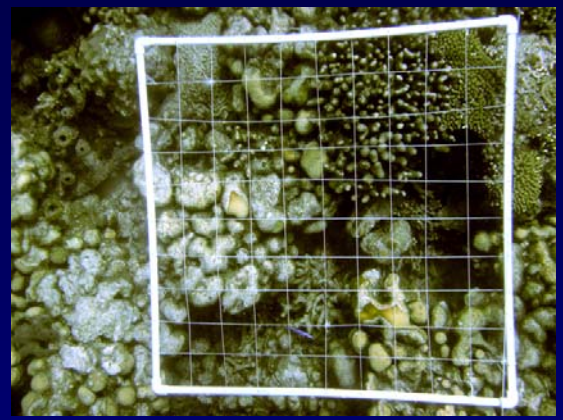
Bleaching – Disease connection



2005

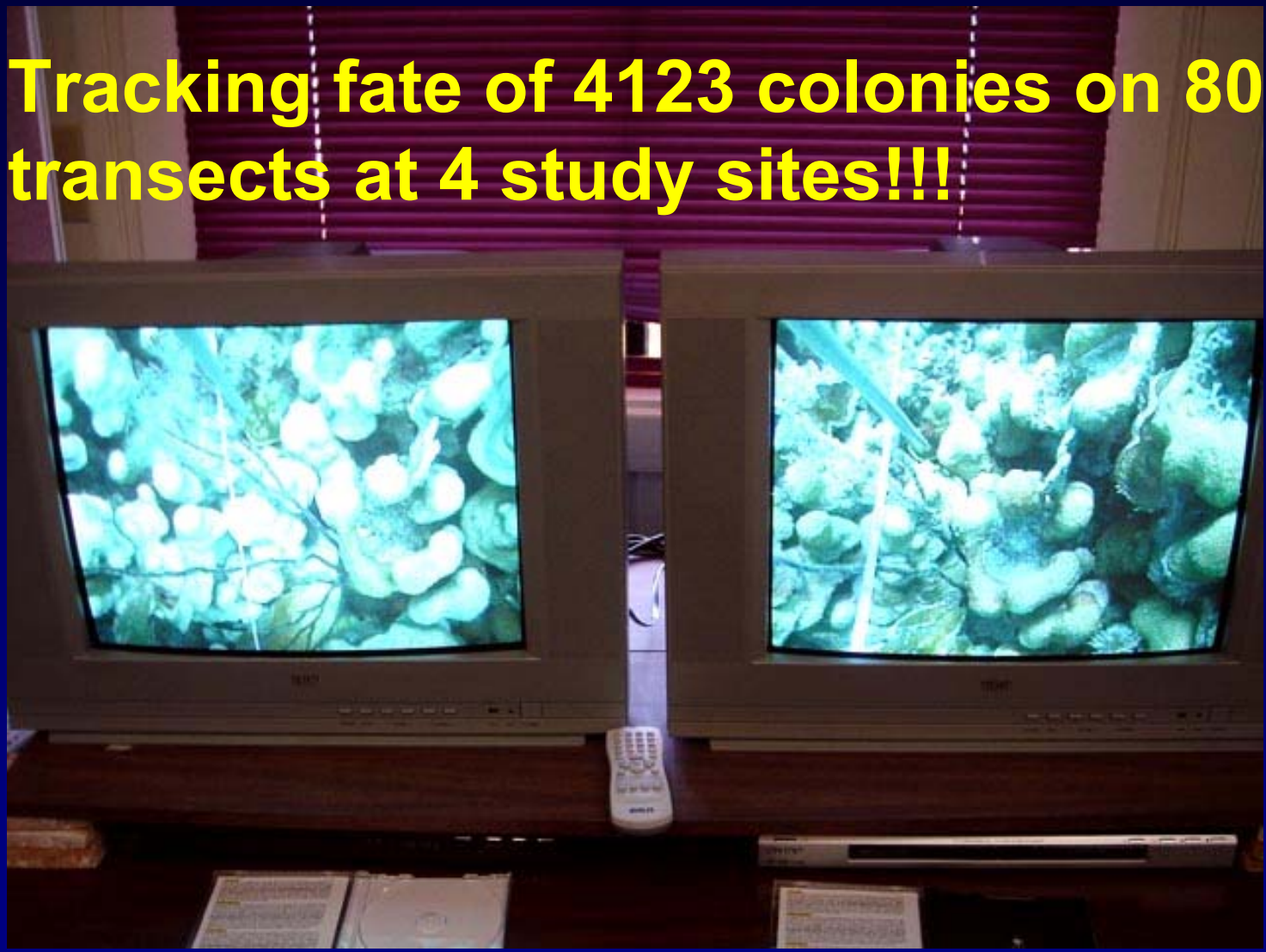


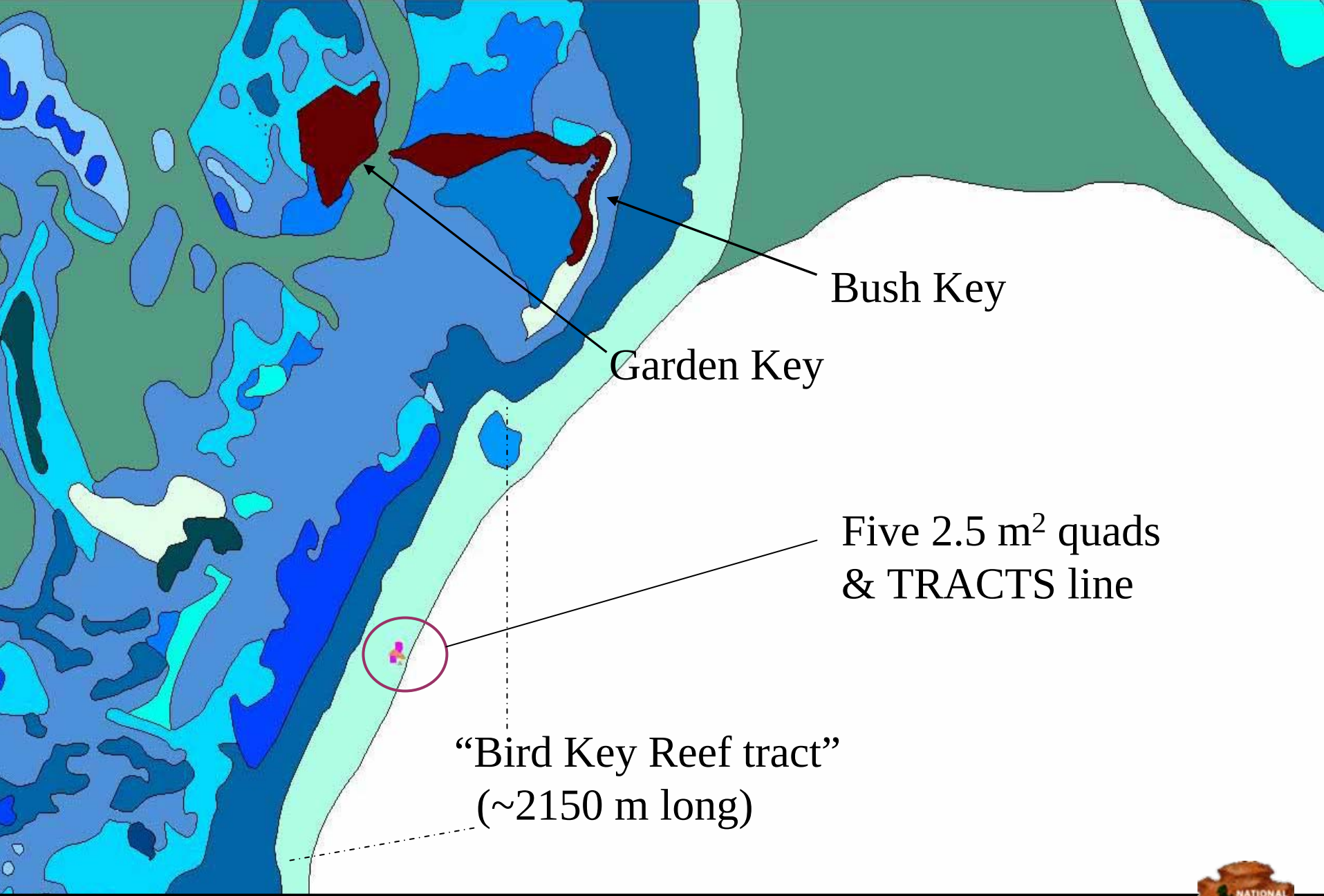
Disease

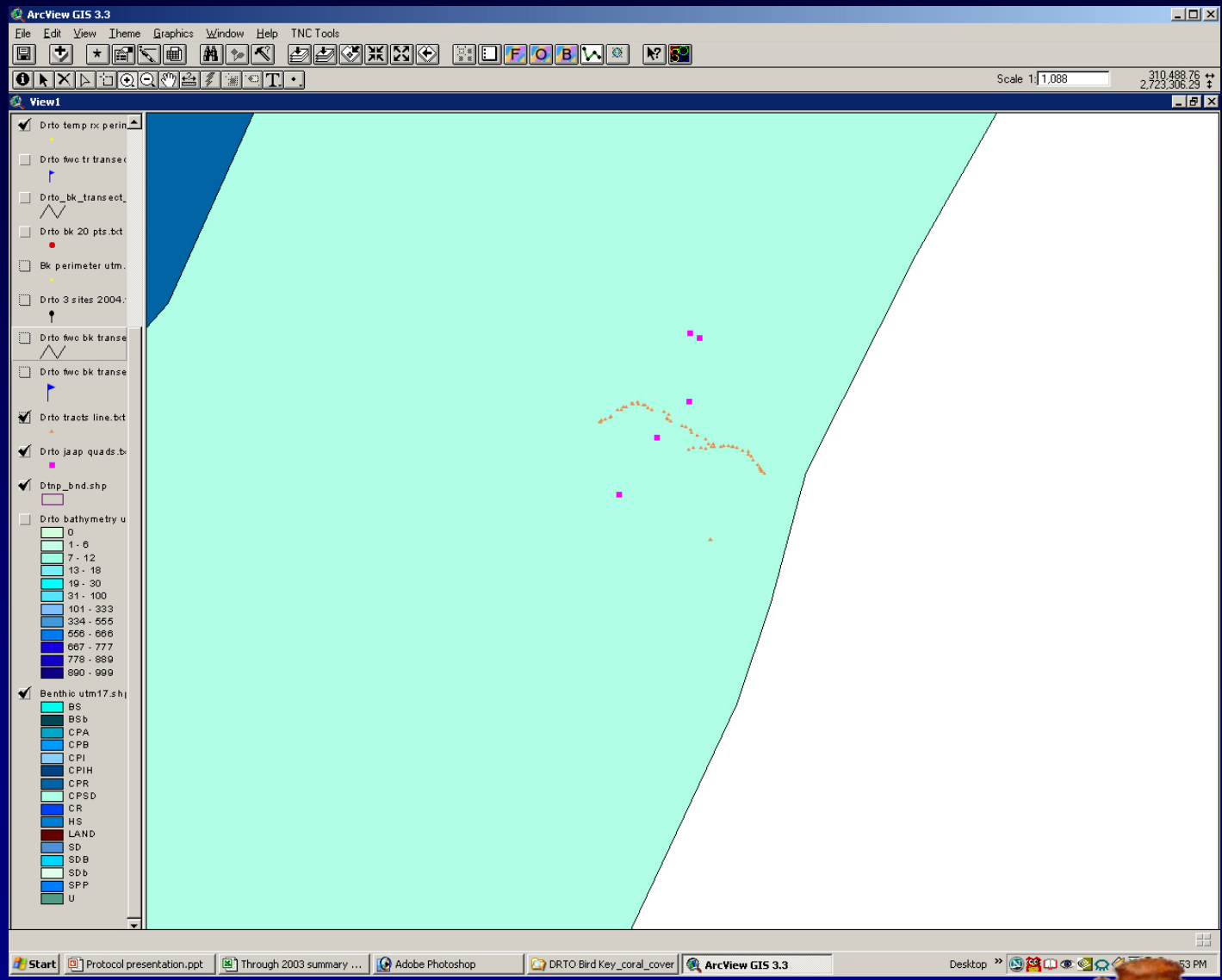


2006

Coral Bleaching Recovery – individual coral tracking




Bush Key
Garden Key
Five 2.5 m2 quads
& TRACTS line
“Bird Key Reef tract”
(~2150 m long)



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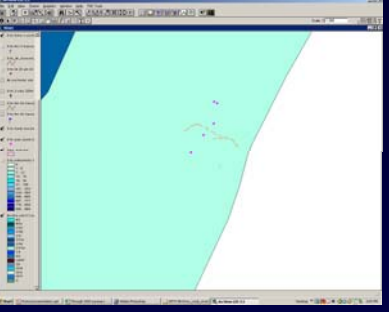

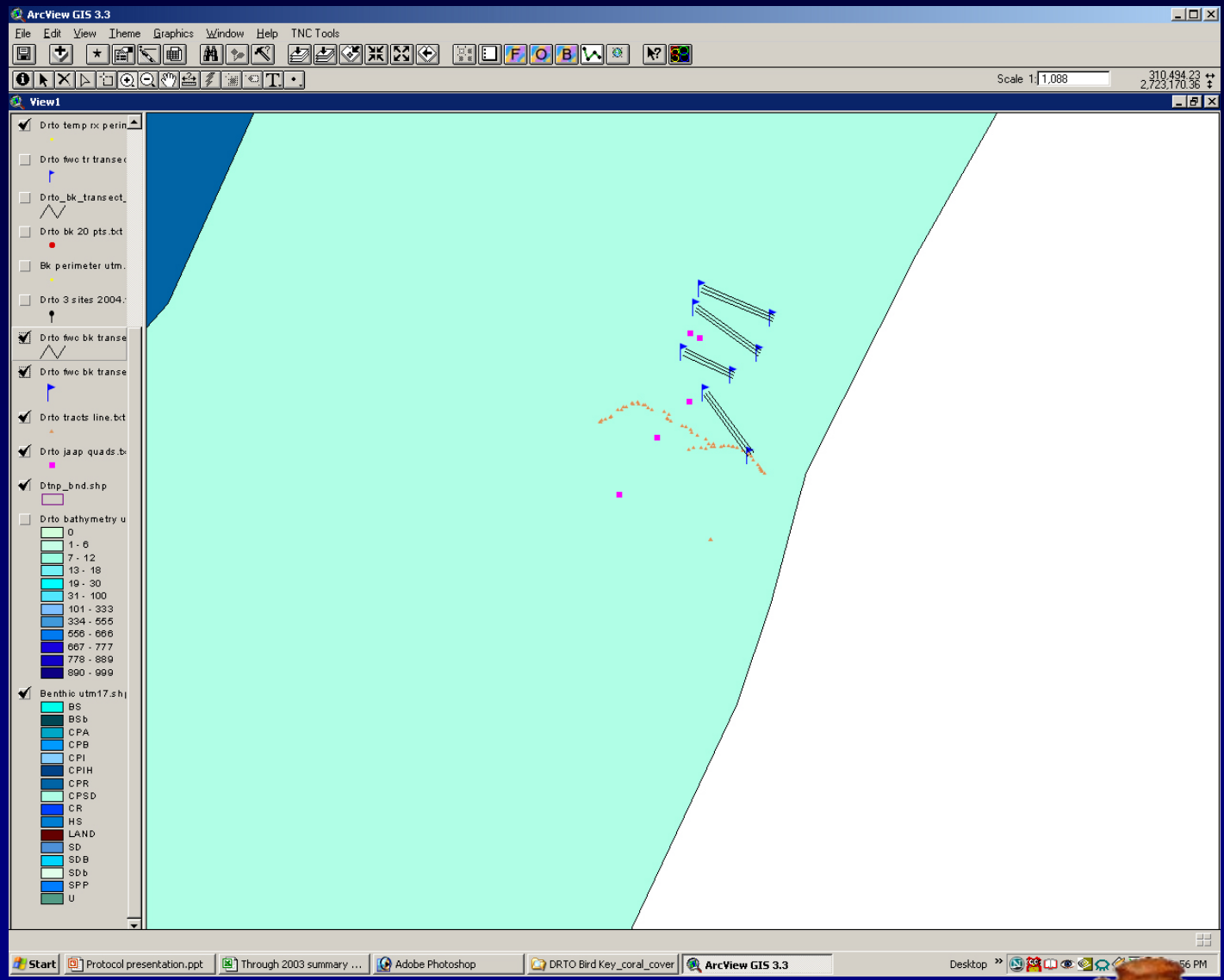

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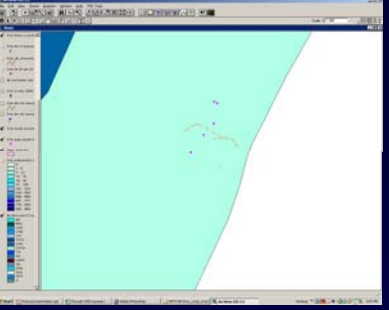

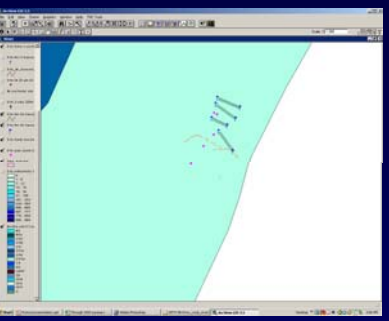

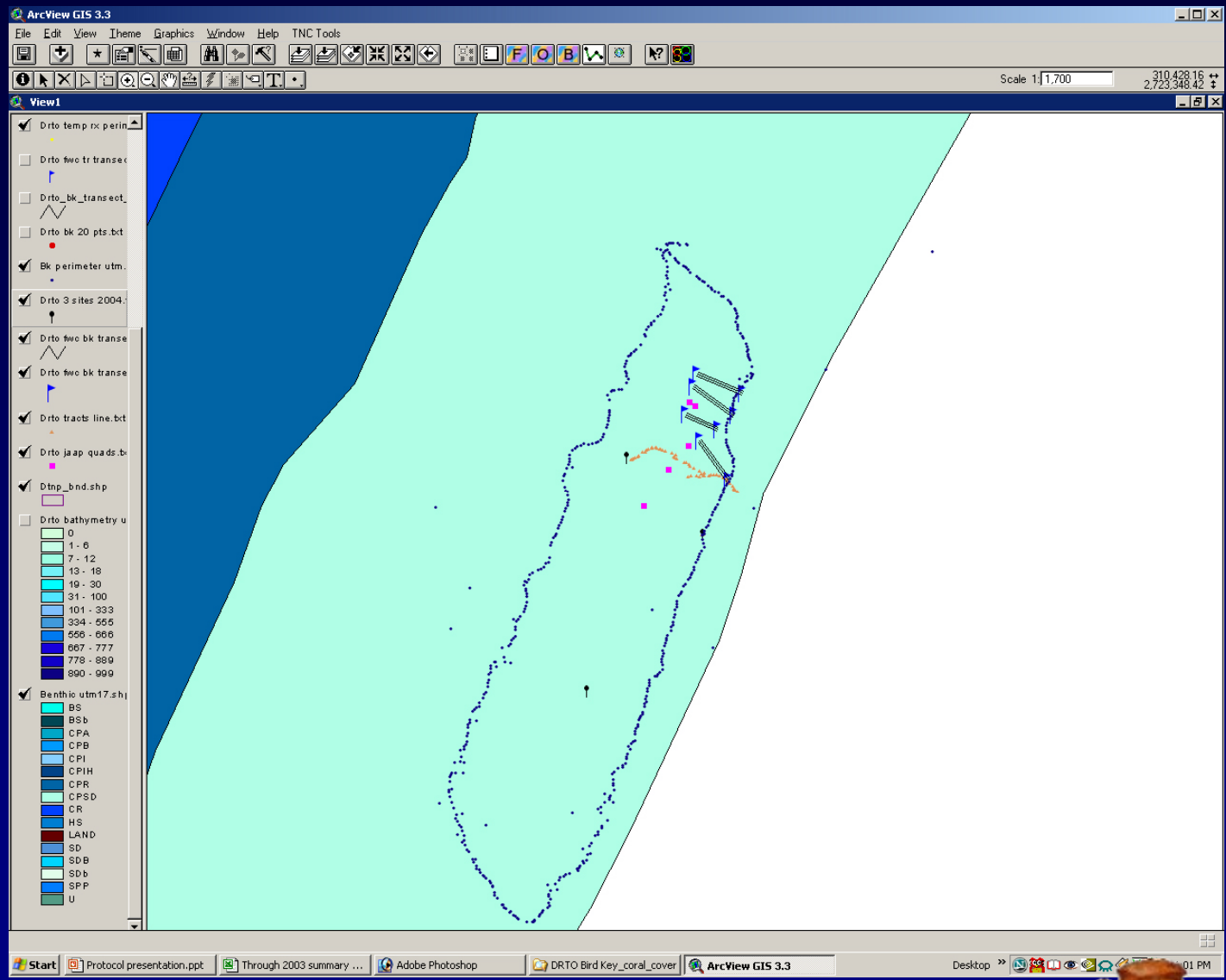

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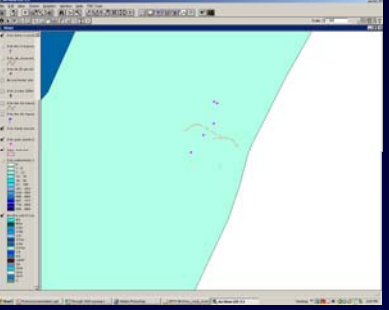

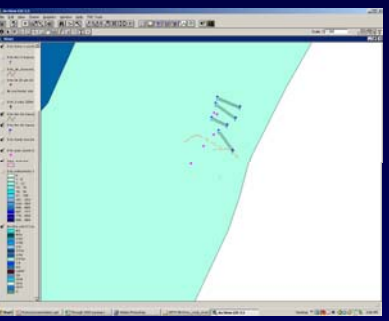

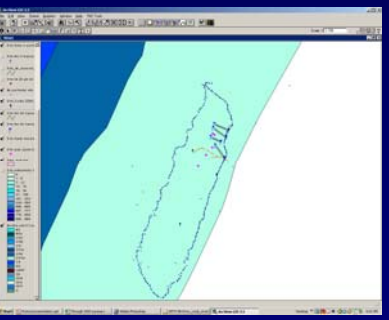

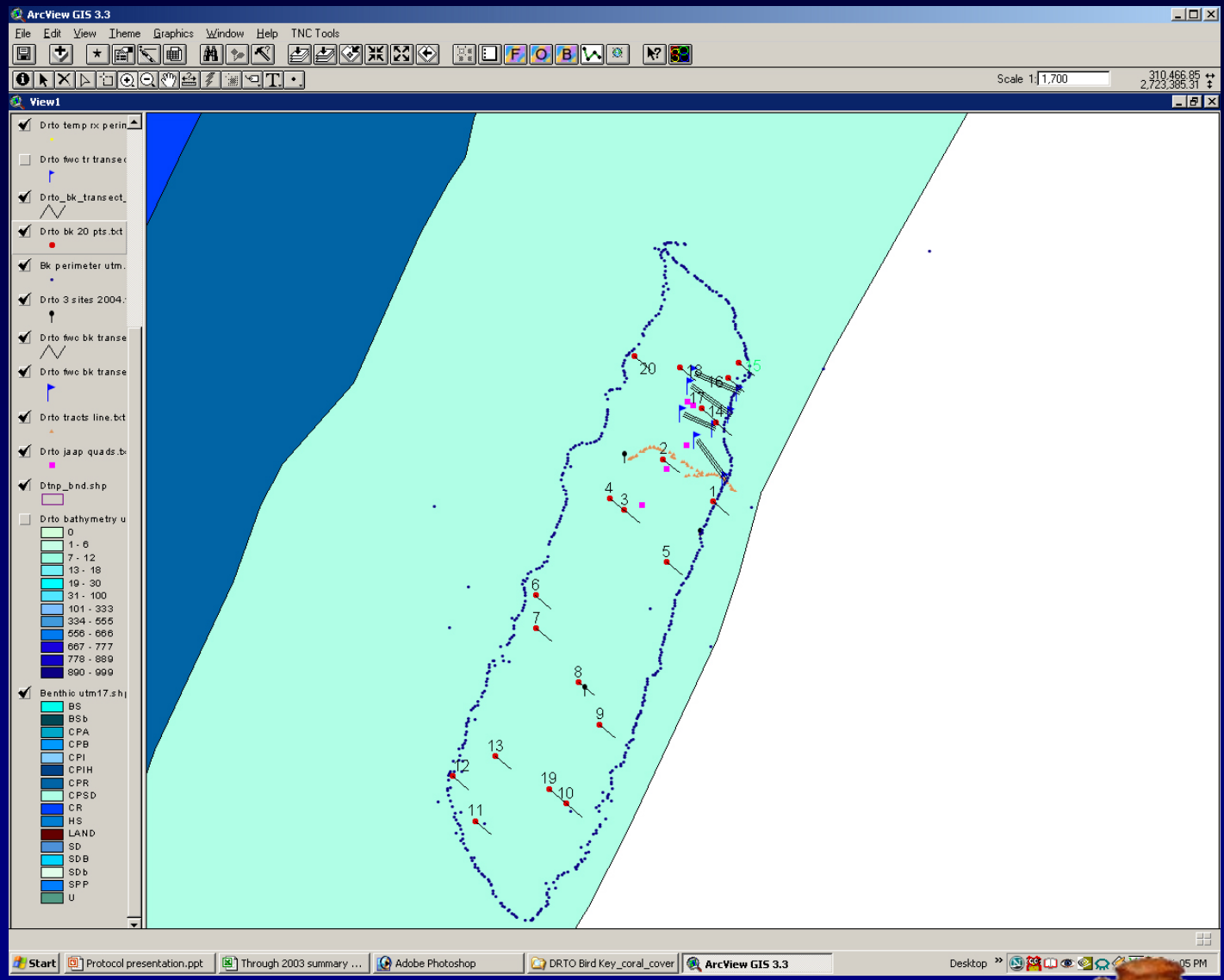

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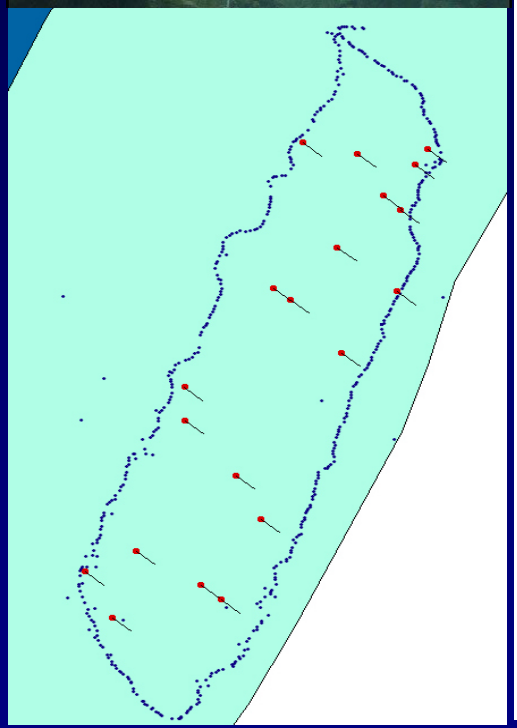
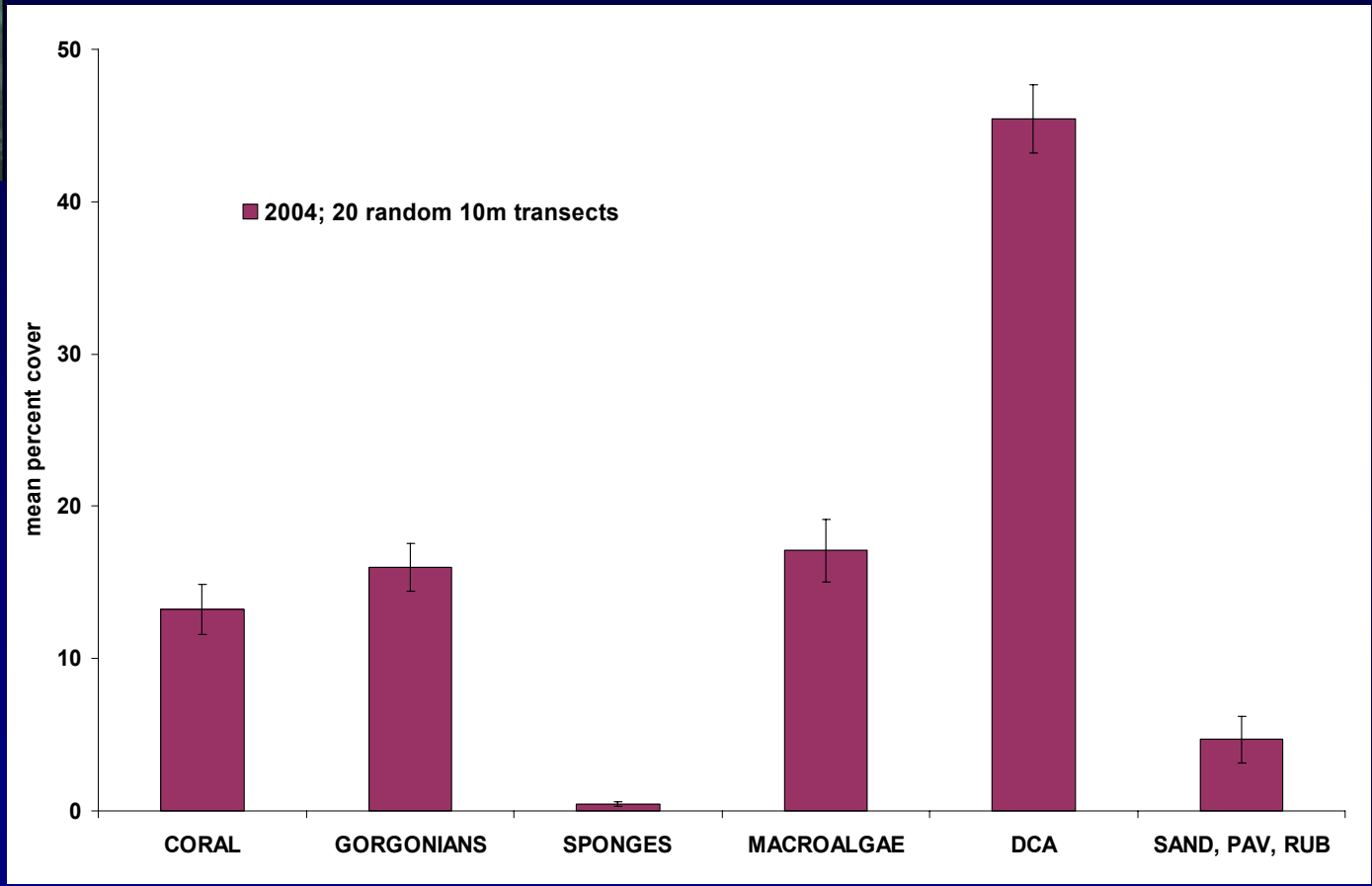
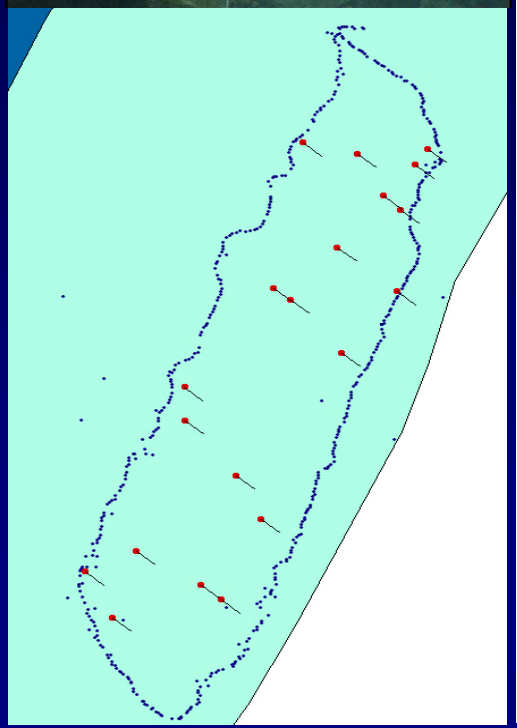
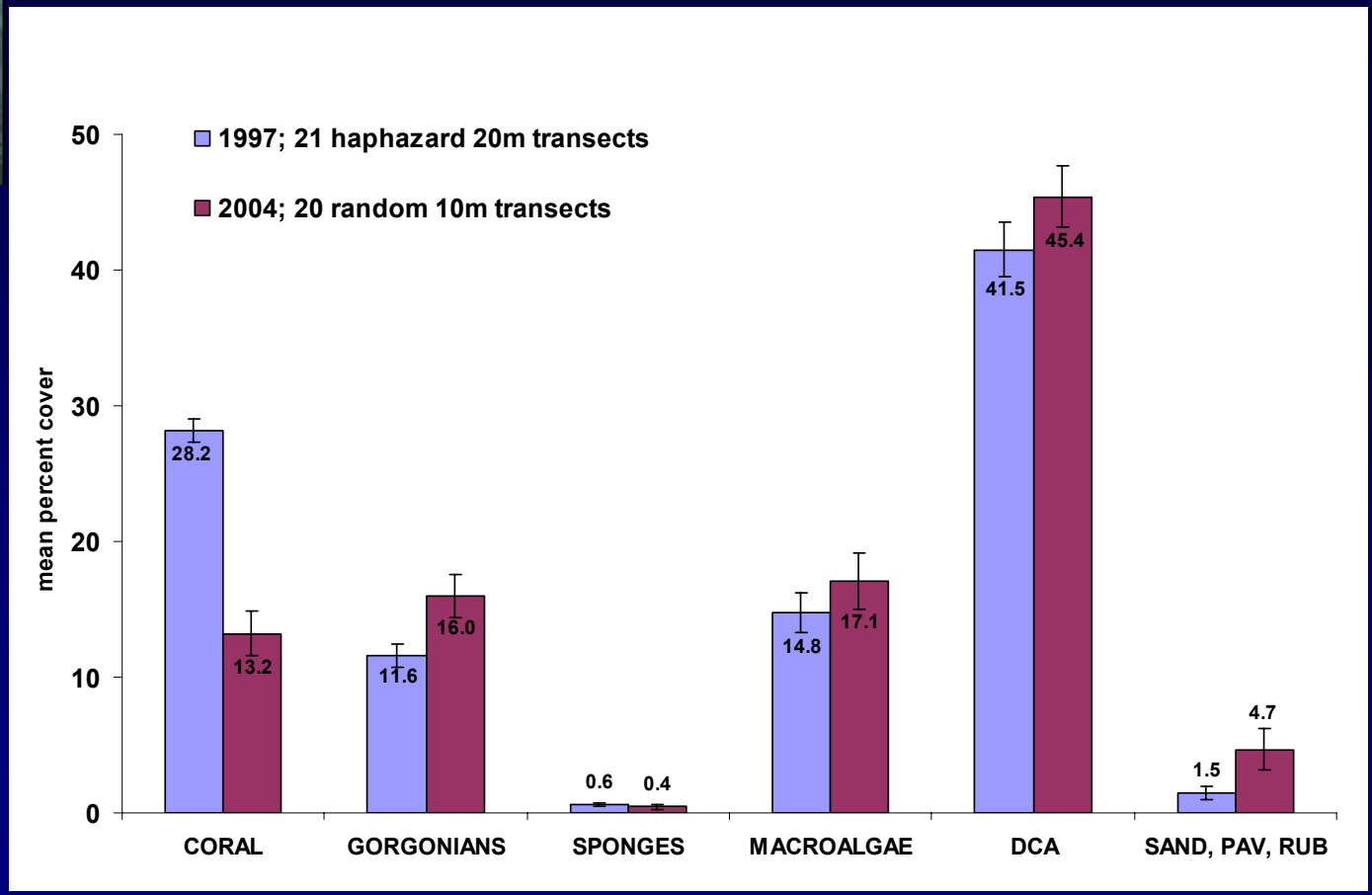


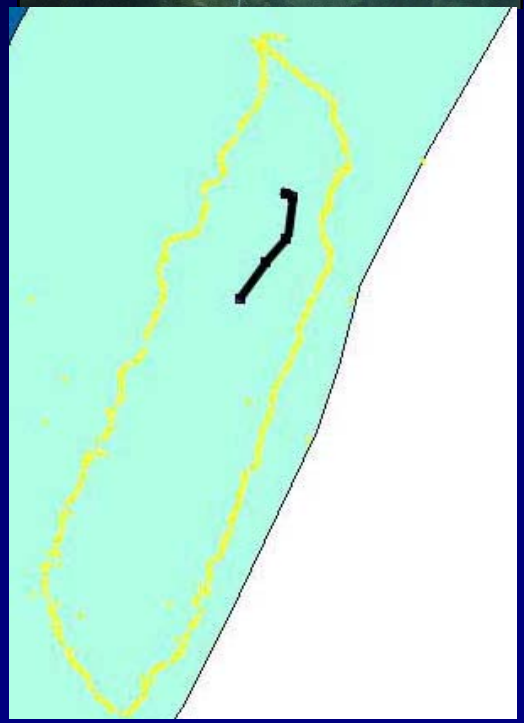
DRTO Bird Key Reef
Sampled: 2004 (20 ten-meter random transects)
Area = 26,365 m^2



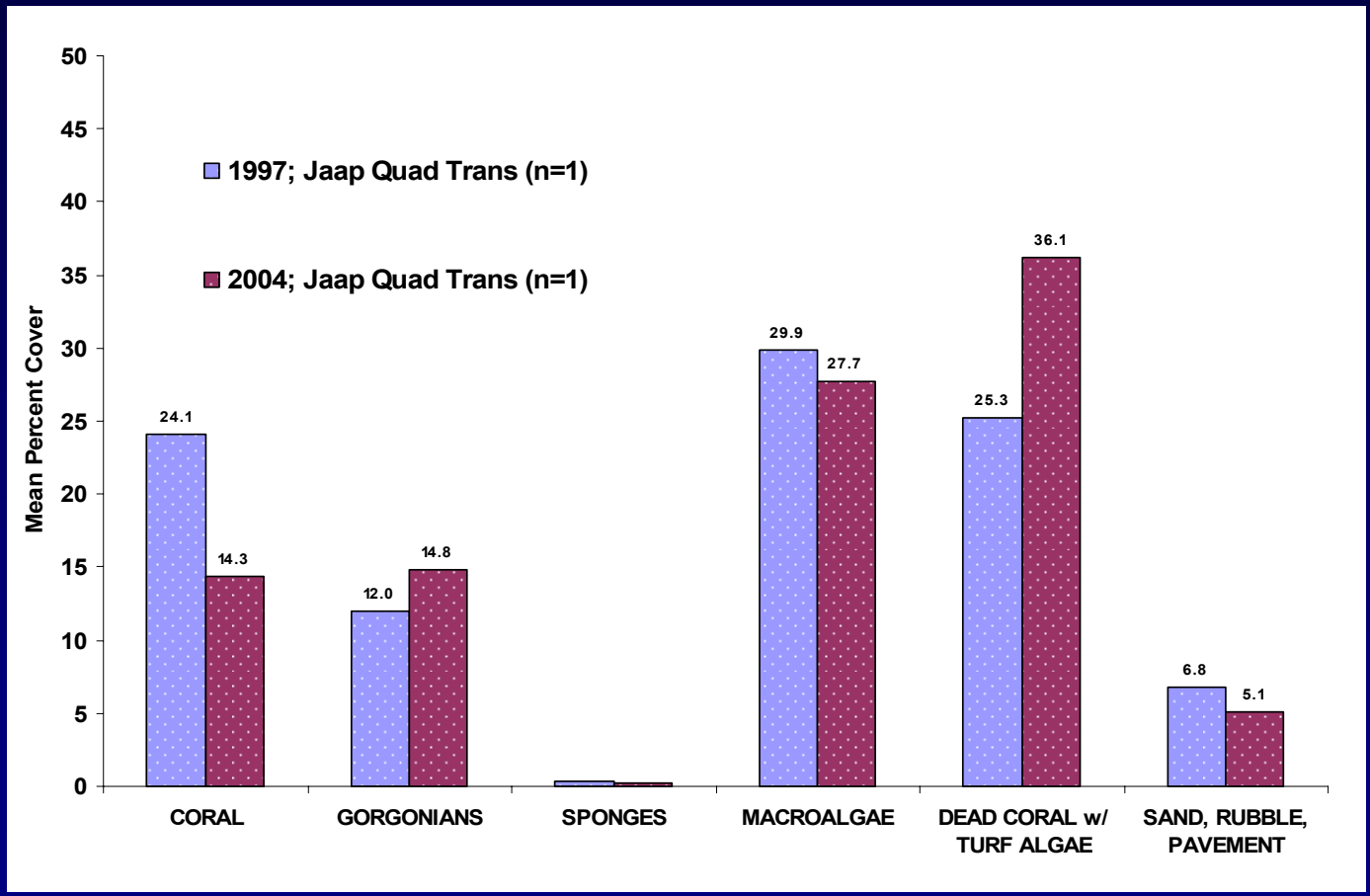


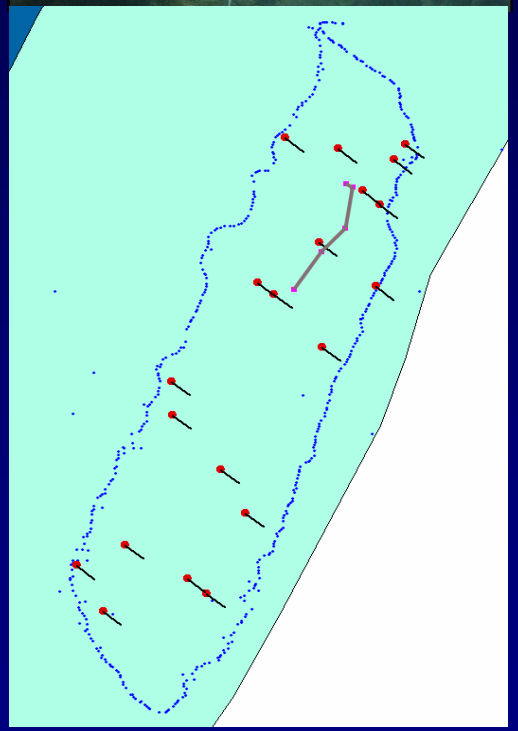
DRTO Bird Key Reef
Sampled: 1997 and 2004
Haphazard vs. Random sampling



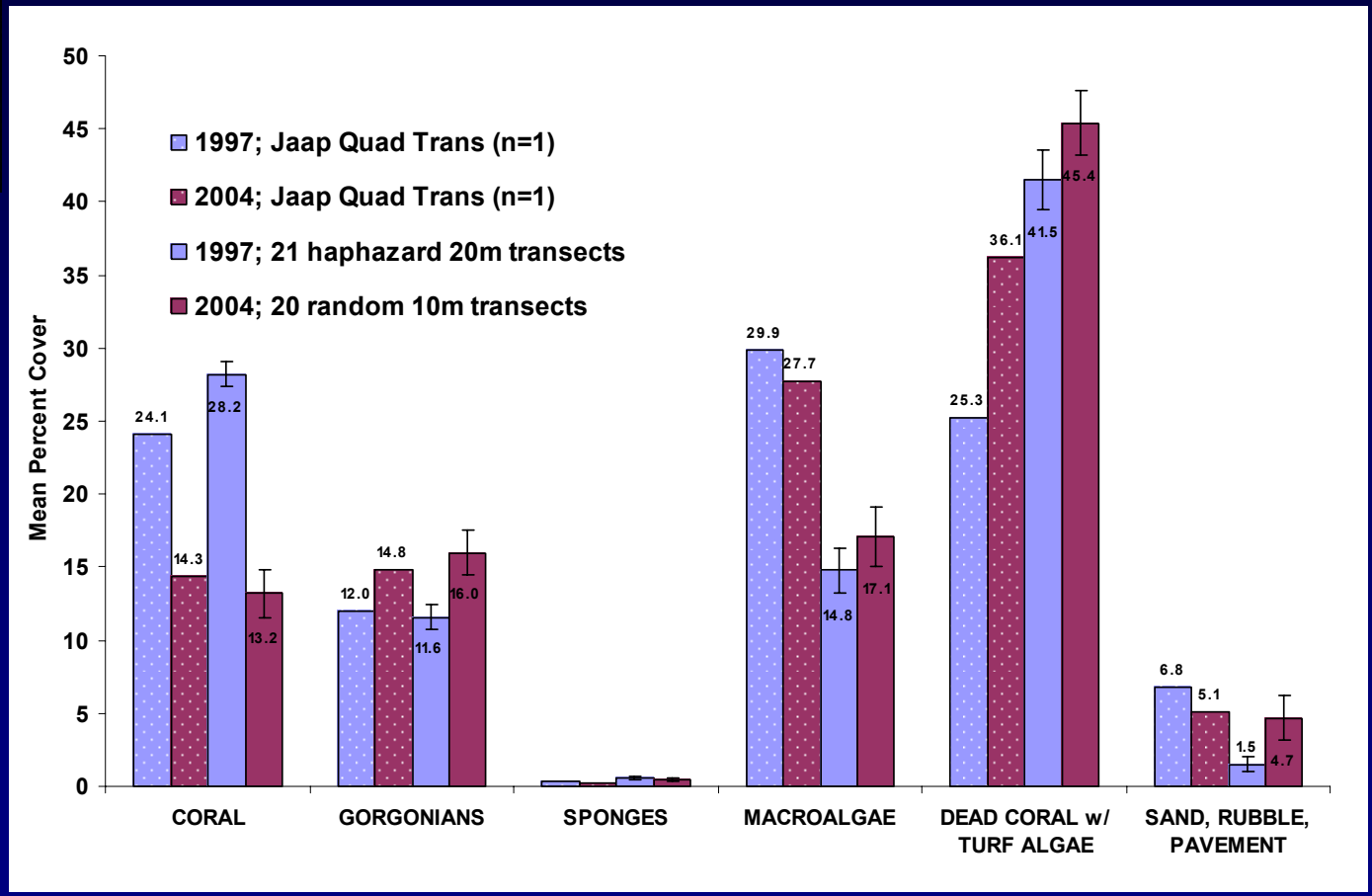


DRTO Bird Key Reef
Sampled: 1997 and 2004
Repeated Sampling of transect between permanent pins





DRTO Bird Key Reef
Sampled: 1997 and 2004
Repeated Sampling of transect between permanent pins



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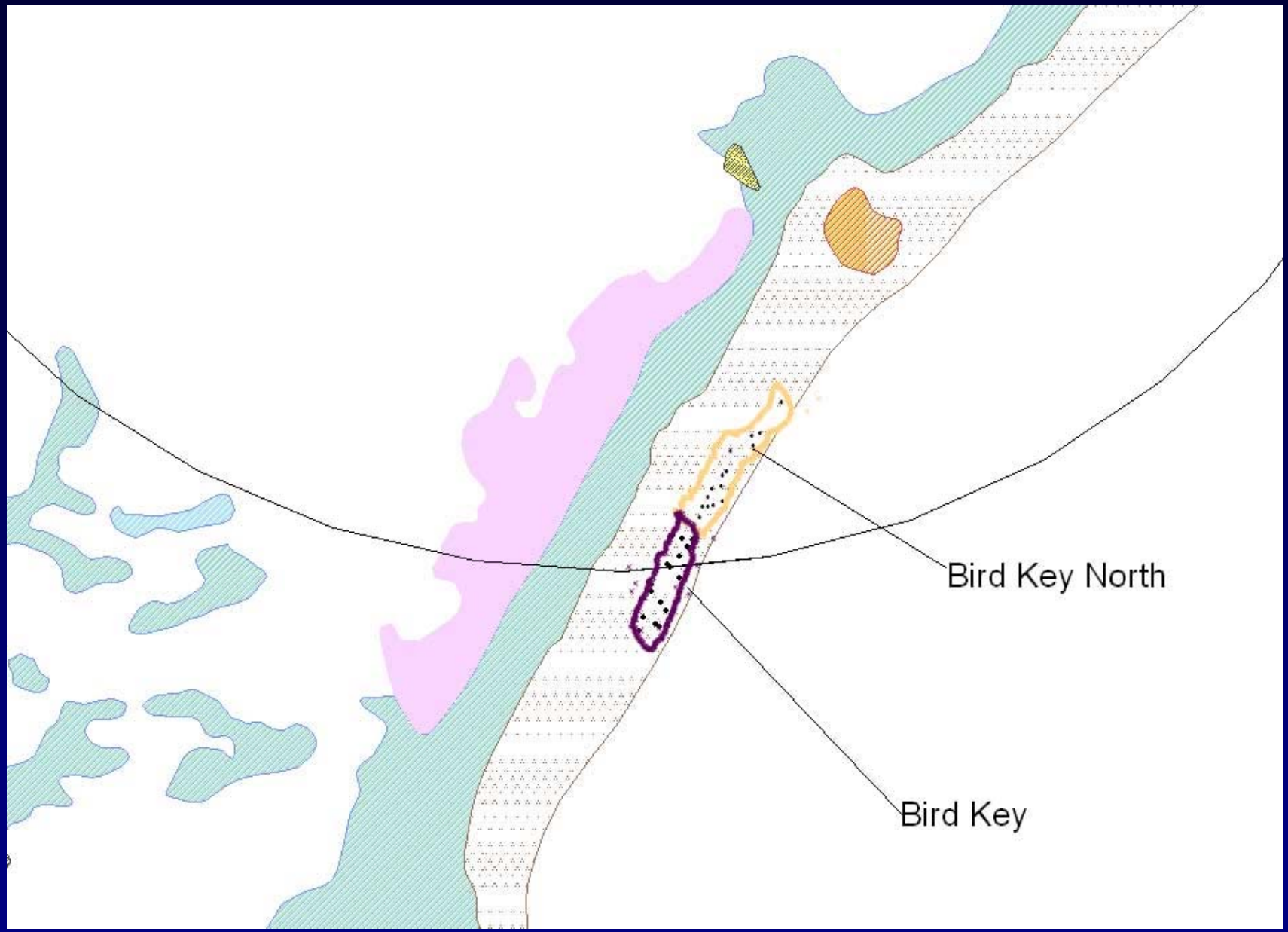
Bird Key North
Bird Key

Summary

- Permanent visual record
- Quantitative and Qualitative data
- Electronic transfer of data and images
- Repeatable, “Power”-ful, rigorous
- Relatively simple and efficient
- Results and images for scientific community and policy-makers

Thank you for your attention.

Any questions?